MYXOMYCETES OF KANSAS

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1940

A THESIS

submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

Department of Botany and Plant Pathology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1941

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INTRODUCTION

The Myxomycetes, Mycetozoa, or slime molds as they are commonly called, have received little attention by the few persons who have previously studied the fungous flora of Kansas. In 1897 and 1898 Roberts (13) made a study of spore germination in various species of slime molds and listed about 26 species which had been collected in the vicinity of Manhattan, Kansas prior to 1898. Bartholomew (1) in 1927 listed 25 species indigenous to Kansas. Over a period of years Prof. P. U. O. Agrelius of Emporia, Kansas collected about 80 specimens which, for the most part, remained unidentified until the present study was made. All told these lists and collections comprise about 45 species, a small number of slime molds in comparison with that reported from other areas.

The present studies were undertaken in an attempt to make additions to the fungous flora of Kansas and North America, to describe the species and varieties of slime molds manifested in Kansas, and to construct keys by which the identification of these species will be facilitated.

REVIEW OF LITERATURE

Comparatively few species of Myxomycetes have been reported from Kansas. Bartholomew (1, 2) in a compiled list of the fungous flora of Kansas reported the following 25 species:

Arcyria denudata (L.) Wettstein, as *A. punicea* Pers.

Arcyria nutans (Bull.) Grev.

Coratiomyxa fruticulosa (Muell.) Macbr., as *Ceratium hydnoides* (Jacq.) Alb. & Schw.

Diachea leucopodia (Bull.) Rost.

Diotydiaethalium plumbeum (Schum.) Rost., as Clathroptychium rugulosum (Wallr.) Rost.

Diderma crustaceum Peck, as Chondrioderma crustaceum Peck

Didymium squamulosum (A. & S.) Fr.

Enteridium olivaceum Ehrn.

Fuligo septica (L.) Webber, as F. septica Link, and F. varians Somm.

Hemitrichia vesparium (Batsch) Macbr., as Hemiarcyria rubiformis (Pers.) Rost.

Licea variabilis Schrad.

Lycogala epidendrum (L.) Fr.

Lycogala flavo-fuscum (Ehr.) Rost.

Mucilago spongiosa (Leyss.) Morgan, as Spumaria alba (Bull.) DC.

Perichaena chrysosperma Lister, as Ophiotheca umbrina Berk.

Perichaena depressa Libert

Physarum cinereum (Batsch) Pers.

Physarum nutans Pers., as P. leucophaeum Fr.

Physarum vernum Somm. (Badhamia verna Rost.)

Stemonitis flavogenita Jahn, as S. ferruginea Ehr.

Stemonitis fusca Roth.

Trichia affinis de Bary

Trichia flaveginea (Batsch) Pers., as T. chrysosperma (Bull.) DC.

Trichia varia Pers.

Tubifera ferruginosa (Batsch) Gmelin, as Tubulina cylindrica (Bull.) DC.

Roberts (13) listed in an unpublished thesis the following 26 species which had been collected in the vicinity of Manhattan, Kansas prior to June, 1897:

Arcyria cinerea (Bull.) Pers., as A. albida Pers.

Arcyria denudata (L.) Wettstein, as A. punicea Pers.

Arcyria incarnata Pers.

Arcyria nutans (Bull.) Grev., as A. flava (Pers.) Bull.

Badhamia macrocarpa Rost.

Comatricha longa Peck

Craterium leucocephalum Ditm.

Cribraria intricata Schrad.

Diachea leucopodia (Bull.) Rost., as D. elegans Fries

Dictydium cancellatum (Batsch) Macbr., as D. umbilicatum Schrad.

Diderma globosum Pers., as Chondrioderma globosum (Pers.) Rost.

Diderma testaceum (Schrad.) Pers., as Chondrioderma testaceum (Schrad.) Rost.

Enteridium rozeanum Wingate

Fuligo septica (L.) Weber

Hemitrichia clavata Pers.

Hemitrichia serpula (Scop.) Rost.

Hemitrichia vesparium (Batsch) Macbr., as H. rubiformis Lister

Lycogala epidendrum (L.) Fries, as L. epidendrum Rost.

Mucilago spongiosa (Leyss.) Morgan, as Spumaria alba DC.

Oligonema nitens Rost.

Perichaena chrysosperma Lister

Physarum cinereum (Batsch) Pers.

Physarum nutans Pers.

Physarum viride Pers.

Physarum wingatense Macbr., as P. compactum Lister

Stemonitis webberi Rex, as S. splendens var. webberi Lister

A single species, Mucilago spongiosa var. solida Lister, was specifically mentioned by Lister as occurring in Kansas (9).

Macbride and Martin (10) specifically mentioned the following four species as occurring in this state:

Badhamia affinis Rost.

Comatricha irregularis Rex

Physarum didermoides (Ach.) Rost.

Trichia decipiens (Pers.) Macbr.

GENERAL DISCUSSION

The slime molds include many delicate, extremely beautiful, chlorophylless organisms that exhibit fungus-like characteristics during the fruiting stage and animal-like characteristics during the vegetative stage. The fruiting stage is the more conspicuous, usually occurring on the surface of the substratum. During the feeding period the vegetative stage resembles a huge multinucleate amoeba with the protoplasm arranged in cordlike streams which commonly assume netted, fanshaped formations. The vegetative stage is more or less obscure and usually remains in the interstices of the substratum until just before fruiting.

Excluded from the Myxomycetes by most writers are several closely related groups of organisms. The Acrasieae resemble the slime molds in the possession of a naked amoeboid stage, but do not form swarm spores nor the true plasmodium of the Myxomycetes. Just before fruiting the "amoebae" of the Acrasieae become aggregated, but do not lose individual identity. The Labyrinthuleae are characterized by a reticulate plasmodium which is thought to be intermediate between that of the Acrasieae and the

Myxomycetes. Because the fruiting stage of the Plasmodiophoraceae lacks the secreted spore case, they have been excluded from the Myxomycetes and are now considered more closely related to the Chytridiales. Since the exclusion of the Plasmodiophoraceae there are now no species of Myxomycetes having a direct economic importance. A few species appear on living economic plants but generally do no harm and soon disappear.

The slime molds are cosmopolitan in distribution, generally occurring wherever there is decaying vegetation and sufficient moisture. While some species are more or less worldwide in distribution, others are restricted to definite regions.

Many species are restricted to certain ecological aspects such as the tropics, mountainous regions, and swamps. Most species occur on decaying vegetation such as wood and fallen leaves, while some develop and fruit on the bark of living trees, especially when the bark is covered with lichens or moss. Several species have been collected on dead stems of cactus, dead attached yucca leaves, and dead Russian thistle.

LIFE HISTORY

The Myxomycetes have long been of interest to both botanists and zoologists because of their unique life history. As the identification is based on the fruiting stage these organisms are usually studied by botanists.

When germination of the spores occurs the contents flow out of the spore membrane and remain motionless for several moments. Amoeboid movements then take place, and shortly afterwards a flagellum is produced on the anterior end of the cell giving rise to the swarm spore. After swim-

ming around for a short time these swarm spores may settle down onto the substratum, lose the flagellum, and again assume amoeboid movements. At that time the "amoebulae" divide. This succession of events may take place a number of times. Finally the "amoebulae" fuse forming a multinucleate mass known as a plasmodium.

The food consists of bacteria that abound in environments favorable for the development of slime molds and, to some extent, of organic material which is in solution. Unicellular algae and inorganic matter may be taken into the plasmodium, but are subsequently discharged. Movement of the protoplasm flows in one direction for about one and a half minutes, then reverses and moves in the opposite direction for about the same length of time, the flow of protoplasm continuing longest in the direction in which the entire plasmodium is moving.

Plasmodia require moist surroundings. Under adverse conditions the plasmodia may change into an inactive, hard mass known as a sclerotium. When favorable conditions return the sclerotium again becomes an active plasmodium.

After an indefinite feeding period or vegetative stage the plasmodium usually comes to the surface of the substratum to fruit. The transition from the slimy mass of protoplasm to the intricate fruiting structures sometimes requires less than 20 hours.

MORPHOLOGY

The morphology of the fruiting bodies of the Myxomycetes is profoundly affected by the environment. Environmental conditions influence the prevalence of slimy species, the amount of lime deposited in the maturing fruit-

ing body, color, the size of the fruiting body and, to some extent, whether it is stalked or sessile, sporangiate, plasmodiocarpous, or aethalioid. Slime molds fruiting under abnormally dry conditions are generally coarser in structure than those fruiting under normal conditions. Immature fruiting bodies subjected to sudden drying often form large odd-shaped spores.

The plasmodium consists of a mass of naked cells gathered into cord-like veins. These veins have a tendency to form a fanshaped network with an almost continuous mass of protoplasm along the active edge of the plasmodium. Plasmodia are tasteless, odorless, and have a consistency similar to the white of an egg. In color plasmodia are perhaps most commonly white, gray, yellow, or brown, but may be orange, red, violet, or green. Characteristics by which species may be identified are seldom found in the plasmodia.

The Myxomycetes are separated into two major divisions: the Exosporeae, and the Endosporeae or Myxogastres. In the Exosporeae the spores are not borne within a sporangium. Ceratiomyxa, the only genus representing the Exosporeae, has stalked spores borne on fragile branching sporophores which are probably equivalent to the hypothallus of the Myxogastres. The spores are ellipsoid and colorless.

The remainder of the Myxomycetes are included in the Myxogastres in which the spores are borne within a sporangium secreted by the plasmodium. Three general types of fruiting bodies are manifested in the Myxogastres; the aethalium, the plasmodiocarp, and the sporangium. These types shade into one another. (a) An aethalium is composed of sporangia confluent to form a more or less compact fruiting body. Sporangium walls on the inside of an aethalium are usually more or less incompletely developed, while the

outer layer or layers of sporangia are often devoid of spores and form the cortex. Aethalia are usually pulvinate and are sometimes 20 centimeters across. (b) A plasmodiocarp is a sessile, elongate, vermiform, netlike or effused fruiting body, and usually appears to have been formed along the veins of the plasmodium. Plasmodiocarpous phases are often found with sporangiate phases, and then usually indicate that the slime mold fruited under adverse conditions. (c) The sporangium is the highest type of fruiting body. Sporangia usually tend to be globose, but are often oblong, cylindric, or irregular. The majority of the Myxomycetes are typically sporangiate.

The fruiting body consists essentially of a sporangium containing spores. In the majority of the slime molds a system of threads called a capillitium is present in the sporangium in addition to the spores. The stalk often continues as a projection into the sporangium. This continuation of the stalk is called the columella. Deposits of calcium salts called lime are typically present in fruiting bodies of the members of Physarales and Diachea. These deposits of lime may be in the form of minute granules or various types of crystals, and are important in identification. The portion of the plasmodium remaining on the surface of the substratum and not involved in the formation of the fruiting bodies is known as the hypothallus.

Usually the sporangium wall consists of a single membranous layer, but in a number of species the sporangium wall is composed of two distinct layers. In other species it is more or less cartilaginous. Although generally persisting for some time after maturity the sporangium wall may be quite evanescent as in many members of the Stemonitales, or in some

species may not even be formed. In Cribraria and Dictydium netlike thickenings in the sporangium wall persist as a delicate net while the thinner portions are evanescent. The capillitium may be completely lacking as in Licea, Cribraria, and related genera.

Except in the Margaritaceae the capillitial threads are tubular in nature. In Badhamia the network of tubes is completely filled with deposits of lime granules. Vesicular expansions filled with deposits of lime granules are characteristic of the capillitium of Physarum and related genera. The capillitia of Physarales and Stemonitales are smooth, but in the Trichiales the capillitial threads may be marked with warts, spines, coge, reticulations, or spirals. In all except the most highly developed species the capillitium is attached to the sporangium wall. However, the capillitium in Trichia consists of comparatively short, simple or sparingly branched threads (elaters) borne free in the spore mass. The spores are unicellular, free or occurring in firm clusters, and range from 4 to 20 mu in diameter. Although usually tending to be globose the spores may be ovoid or elliptical. The walls of the spores are seldom smooth, usually being marked with warts, spinules, or reticulations. When observed by transmitted light the spores range from almost colorless to dark brown.

LOCALITIES

During the period from 1936, when the present study was begun, to 1941 the weather has been erratic. Often for long periods of time slime molds were not found fruiting or if so they were in an abnormal state of maturity. Certain habitats were found to be less affected by erratic changes in weather, and more collections were taken from these areas.

For the most part the present collecting has been in Geary and Riley counties, but to some extent in Edwards and Saline counties. Slime molds often appeared in abundance along timbered stream bottoms, in timbered ravines, and in thickets. Of special interest in Geary County was Eagle Eye Canyon, a small ravine about a quarter of a mile in length, which had an abundant growth of timber but no obvious supply of moisture except immediately after rains. It has yielded approximately 60 species including such rare species as Diachea subsessilis Peck, Didymium listeri Massee and Licea tenera Jahn. In a nearby shallow ravine the sparsely timbered banks had an undergrowth of shrubs and poison ivy under which moisture was well retained and large fruitings of Myxomycetes often reached full maturity. This ravine is the type locality of Didymium parietale Martin and Brooks.

An old abandoned orchard on the southwestern edge of Junction City, Kansas remained undisturbed for over ten years before it was cleared and burned. It was the source of several rarely collected species. Physarum aeneum (List.) R. E. Fries was collected there for the first time outside of the tropics. P. maculatum Macbride had not been reported outside of Central America until collected in this orchard. P. megalosporum Macbride, previously collected only in Colorado, was found fruiting abundantly.

During the summer and fall of 1940 collecting was done almost exclusively in Hackberry and Papaw Glens which are located southeast of Manhattan. These deep wooded ravines were almost undisturbed. In the drier areas Physarum bivalve Pers. appeared abundantly with other species seldom present. A rarely collected species, P. listeri Macbride, often occurred there in densely compacted piles of wet leaves. Diachea bulbillosa (Berk. & Br.) Lister, D. splendens Peck, and Physarum superbum Hagelstein fruited abundantly along the slopes.

The rarely collected species Didymium listeri, D. ochroideum G. Lister, D. parietale, and Perichaena syncarpon Brooks were collected on leaves beneath ornamental shrubs on the campus of Kansas State College at Manhattan.

Many of the collections made in Edwards County were imperfectly developed because they were subjected to rapid drying while fruiting. Myxomycetes were found to be common on fallen leaves and decaying wood, but were especially abundant on dead Russian thistle plants which had become lodged in groves and on leaves and twigs beneath the Russian thistle. A fruiting of Perichaena syncarpon was found on a leaf beneath Russian thistle in a grove along Rattlesnake Creek.

MATERIALS AND METHODS

Generally slime molds may be found wherever decaying vegetation occurs under moist undisturbed conditions. They are commonly found on a variety of habitats such as dead wood and bark, the inner bark of dead trees, associated with lichens and algae on the bark of living trees, fallen leaves, dead herbaceous plants, moss, and dung. If, on examination of a likely locality, plasmodia, plasmodial tracks, or a few species were found, frequent visits and intensive search usually brought to light additional species.

Small boxes or similar containers were used so the specimens could be transported to the laboratory with the minimum of damage. Each collection was kept in a separate container or compartment to avoid the mixture of spores since there are so many intermediate forms in which spore characteristics are often of importance in their identification. A stout knife was usually sufficient for removing specimens from bark or wood.

Tentative identification in the field was often aided by use of a hand lens.

In addition to collecting in the field, another method of obtaining specimens was employed. This consisted of removing pieces of the outer bark from the base of trees and culturing the bark in the laboratory.[1] Bark from such trees as American elm, cottonwood, willow and oak was used in these studies. Bark bleached by sap was not satisfactory for culturing. The bark was placed in a moist chamber and saturated with distilled water for about 24 hours, the excess water was removed, then the chamber was placed under good growing conditions. Fruiting bodies usually began appearing in about a week, but in some cultures they did not appear for a month or more. When small containers such as petri dishes were used the conditions were difficult to control and only small fructifications were obtained. In the use of large amounts of bark in large chambers the conditions were more easily controlled and larger, more perfectly matured fruitings were obtained. The moist chamber method of development proved especially satisfactory during winter months when field collecting was unsatisfactory or impossible. A number of species usually too small for detection in the field were found.

The microscopes used in these studies included a Spencer semiresearch binocular microscope which was used with 15x compensating oculars and 8 mm dry and 2 mm N. A. 1.25 oil immersion objectives giving respective magnifications of 300x and 1425x, and a Spencer wide field binocular microscope which was used with 12.5x oculars and 1.0x and 4.8x objectives giving

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[1] This method of collecting was suggested by Dr. C. W. Martin, State University of Iowa, Iowa City, Iowa, in personal conversation, November, 1937.

respective magnifications of 12.5x and 60x. A Spencer desk microscope lamp served as the source of light. For studies with the semiresearch model a daylight filter was used to cut down the intensity of light and to reduce eye strain, but for studies of grosser details under the wide field microscope, the lamp was used without the daylight filter. Better detail was obtained in oil immersion studies by using cedar oil between the condenser and the slide, as well as between the cover slip and the oil immersion objective.

DESCRIPTIONS OF KANSAS MYXOMYCETES

The following descriptions are of material collected in Kansas for this study. The majority of the species and varieties described in this thesis have been verified or identified by Mr. Robert Nagelstein or by Dr. G. W. Martin. Representative specimens of many of the species have been deposited in the cryptogamic herbarium at the Department of Botany and Plant Pathology, Kansas State College.

The descriptions of microscopic details and measurements of spores and capillitia were made from oil immersion studies of material mounted in 3 percent potassium hydroxide.

KEY TO FAMILIES OF MYXOMYCETES

1. Spores borne within a fruiting body.
   2. True capillitium present and usually well developed.
      3. Spores in mass varying shades of brown to nearly black; capillitial threads smooth and hollow.
         4. Deposits of lime typically present in some portion of the fruiting body.

5. Lime present as minute granules; capillitium generally branching and anastomosing to form an intricate network of threads which usually contain deposits of lime. . . . . 1. Physaraceae.

5. Sporangium wall generally with deposits of lime in the form of stellate crystals or scales; capillitium composed usually of simple or sparingly branched threads without deposits of lime. 2. Didymiaceae.

4. Deposits of lime lacking, or when present restricted to the stalk, columella, and hypothallus . . . . . 3. Stemonitaceae.

3. Spores in mass varying shades of yellow or red; capillitial threads usually sculptured.

4. Capillitium composed of hollow threads.

5. Capillitial threads sculptured with spines, warts, cogs, or rings, but not with spiral bands. . . . 4. Arcyriaceae.

5. Capillitial threads with more or less prominent spiral bands. 5. Trichiaceae.

4. Capillitium composed of solid threads. . . 6. Margaritaceae.

2. True capillitium absent; a pseudocapillitium of perforated plates or threads often present.

3. Plasmodic granules present in the sporangium wall. 7. Cribrariaceae.

3. Plasmodic granules absent in the sporangium wall.

4. Fructification of distinct sporangia or plasmodiocarps; pseudocapillitium absent. . . . . 8. Liceaceae.

4. Fructification aethalioid.

5. Sporangia well defined, tubular. . . . . 9. Tubiferaceae.

5. Sporangia not well defined.

6. Pseudocapillitium composed of perforated plates or frayed threads. . . . . 10. Reticulariaceae.

6. Pseudocapillitium composed of irregular branched tubules. 11. Lycogalaceae.

1. Spores borne on fragile branching sporophores, ellipsoid, colorless (represented by the single genus Ceratiomyxa, which is common on wood in Kansas but is not discussed in the thesis). 12. Ceratiomyxaceae.

FAMILY PHYSARACEAE

Fruotification aethaloid, plasmodiocarpous, or sporangiate. Sporangium wall single, or composed of two layers, with deposits of lime in the form of minute granules. Capillitium usually intricate and with deposits of lime granules.

KEY TO GENERA OF PHYSARACEAE

1. Sporangia interwoven to form a pulvinate aethalium. 1. Fuligo.

1. Fruotification plasmodiocarpous or sporangiate.

2. Capillitium typically with deposits of lime.

3. Capillitium a network of tubes filled throughout with lime granules. 2. Badhamia.

3. Capillitium a network of threads with vesioular expansions containing lime granules.

4. Capillitium with sicklelike branches. . . . 3. Cienkowskia.

4. Capillitium without sicklelike branches.

5. Sporangia shortly cylindric, deeply umbilicate. 4. Physarella.

5. Sporangia not deeply umbilicate.

6. Dehiscence circumscissile. . . . . 5. Cratorium.

6. Dehiscence irregular . . . . . 6. Physarum.

2. Capillitium typically without deposits of lime. 7. Diderma.

Genus 1. Fuligo Haller emend. Pers.

Sporangia interwoven to form a pulvinate aethalium, often with the outer layer of sporangia without spores forming a cortex charged with

deposits of lime granules. Capillitium a network of simple or branched threads with many or few lime knots.

Key to Species of Fuligo

1. Spores mostly elliptical.

2. Cortex white. . . . . 1. F. cinerea.

2. Cortex absent, outer layer of sporangia containing spores.
1a. F. cinerea scorticata.

1. Spores mostly spherical.

2. Spores usually less than 10 mu in diameter; cortex usually present.
2. F. septica.

2. Spores 10.6-12.2 mu in diameter; cortex absent. . . 3. F. intermedia.

1. Fuligo cinerea (Schw.) Morgan. Aethalia gregarious or scattered, pulvinate or elongate, 2-20 mm in extent, white. Sporangia constituting the aethalium closely interwoven and inclosed within a more or less smooth cortex densely charged with white lime granules. Sporangium walls within the aethalium incomplete, membranous, with deposits of white lime granules. Hypothallus often scanty, membranous, more or less densely charged with white lime granules. Capillitium composed of simple or branched, colorless threads connecting large irregular lime knots which often fuse to form a nucleate mass of lime. Spores in mass violet-brown, violet-brown by transmitted light, spinulose, when ellipsoid 11.7-14 x 14.4 - 15.5 mu, or when subglobose 12.2-16.1 mu in diameter.

On dead leaves, weed stems, sorghum stalks, etc. Kansas; TEB 596, collected by the writer and Mrs. Brooks in Edwards County, August 4, 1940; TEB 621, Geary County, August 18, 1940; TEB 631, collected by Mrs. Brooks in August, 1940.

The cortex of a single aethalium of TEB 621 is unusual in the presence of translucent yellow discoidal inclusions charged with lime granules.

1a. Fuligo cinerea ecorticata Lister. Aethalia without a cortex; the outer layer of sporangia irregular in outline and containing spores. Spores smaller and paler than in the typical form.

A few aethalia of var. ecorticata were found among the typical aethalia in TEB 596 collected by the writer and Mrs. Brooks in Edwards County, Kansas, August 4, 1940.

2. Fuligo septica (L.) Weber. Aethalia pulvinate, 0.7-10 cm or more in extent, 3-12 mm or more thick, tawny, yellow, greenish yellow, brown, or white in color. Sporangia constituting the aethalium closely interwoven and inclosed within a spongy, calcareous cortex. Sporangium walls within the aethalium complete or incomplete, membranous, with deposits of white, yellow, or greenish yellow granules of lime. Capillitium abundant or scanty, composed of branched colorless threads with white or yellow lime knots. Spores brown in mass, purplish brown by transmitted light, globose, spinulose to nearly smooth, 7.8-19.6 mu in diameter.

Common on the ground, straw, leaves, and wood. Observed many times but few collections were made. Kansas: collected by the Kansas State Agricultural College Botanical Club near St. George, August 1, 1893; H. F. Roberts 4a, Riley County, August, 1897; Geary County, June 26, 1938; TEB 368, Geary County, July, 1937.

3. Fuligo intermedia Macbride. Aethalia gregarious or scattered, 2-20 mm in extent, 2-5 mm thick, white, buff, ochraceous, brown, or olive in color. Sporangia constituting the aethalium closely interwoven, with airspaces between the sporangia. Cortex absent, the outer layer of

sporangia perfectly developed and inclosing spores and capillitium. Sporangium wall within the aethalium complete, usually composed of two layers, the outer layer smooth, subcartilaginous, with scanty deposits of lime granules, closely adhering to the membranous inner layer which has scanty deposits of white lime granules. Hypothallus well developed or scanty, membranous, reddish brown to nearly colorless. Capillitium white, a network of broad or narrow tubes, charged with granules of lime, usually more densely developed towards the center of the sporangium to form a pseudocolumella. Spores brown in mass, purple-brown by transmitted light, globose, closely warted, and marked with patches of darker warts, 10.6-12.2 mu in diameter.

On dead wood. Kansas: H. F. Roberts 2, as F. ellipsospora Lister, Riley County, fall of 1896; TEB 632, collected by Mrs. Brooks in Edwards County, August 13, 1940; TEB 643, Riley County, September 15, 1940; TEB 677, Riley County, September 22, 1940.

Nagelstein (5) described similar developments from Schoharie County, New York, which he considered closer to F. septica than to F. cinerea, although showing resemblance to the latter in the larger, darker spores, and the more robust capillitium. Nagelstein stated that Martin considered the New York specimens as Fuligo intermedia, but that his description which does not agree, was incorrect.[2/]

Several aethalia in TEB 643 have thin, membranous sporangium walls covered with crystalline discs of lime, and an abundant capillitium of colorless threads without deposits of lime.

[2/] Personal correspondence from Robert Nagelstein, Long Island, New York, September 24, 1940.

Genus 2. Badhamia Rost.

Sporangia gregarious or crowded, sessile or stalked, or forming plasmodiocarps. Sporangium wall membranous, with dense or scanty deposits of lime granules. Capillitium a network of tubes more or less densely charged with granules of lime.

Key to Species of Badhamia

1. Spores adhering in firm clusters. . . . . 1. B. papaveracea.

1. Spores free.

2. Discoid or hemispheric sporangia sessile or on black stalks. 2. B. orbiculata.

2. Sporangia subglobose or reniform, with yellow or straw colored stalks.

3. Capillitium a delicate network of tubes with scanty deposits of lime. . . . . 3. B. gracilis.

3. Capillitium coarse with abundant deposits of lime. 4. B. macrocarpa.

2. Stalk when present dark red; sporangia usually seated on a dark red hypothallus. . . . . 5. B. panicea.

1. Badhamia papaveracea Berk. & Rav. Sporangia gregarious or crowded, sessile or short stalked, subglobose, 0.5-0.8 mm in diameter, gray, iridescent in absence of lime. Sporangium wall membranous, fragile, colorless, rugose, with scanty deposits of white lime granules usually clustered to form a loose reticulation of narrow lines, breaking irregularly. Stalk short, black, opaque, charged with granular matter, expanding below into a poorly developed hypothallus. Columella none. Capillitium a network of slender flattened threads containing deposits of white lime granules evenly but not densely distributed throughout. Spores dark purple-brown in mass, purple-brown by transmitted light, adhering in firm globose

clusters of 4-13, strongly spinulose on the outer surface, 11-13 mu in diameter.

A single collection on wood in Riley County, Kansas in the fall of 1935. Other data unknown.

Readily recognized by the gray sporangia mounted on short dark stalks, and the spores adherent in firm clusters.

2. Badhamia orbiculata Rex. Sporangia gregarious, crowded, or scattered, sessile or short stalked, discoidal or almost annulate, often hemispheric, 0.5-1.2 mm across, or forming short flattened plasmodiocarps, grayish white, iridescent in absence of lime, dehiscing irregularly. Sporangium wall membranous, fragile, colorless, with small clustered deposits of white lime granules. Stalk 0.2 mm or less in length, stout, furrowed, opaque, nearly black. Hypothallus dark, scanty. Columella none. Capillitium consisting of simple rodlike tubes, or a network of tubes containing white lime granules. Spores in mass light brown to purple-brown, pale violaceous brown, violet-brown, or purple-brown by transmitted light, globose to ovoid, minutely spinulose, usually with a pale line of dehiscence, 10-15 mu in diameter.

Common on bark and branches of dead boxelder trees.

Kansas: F. U. G. Agrelius 60, Harvey County, August 21, 1907; TEB 261, Geary County, July 2, 1938; TEB 483, Geary County, July 17, 1938; TEB 630, Geary County, June 26, 1938; TEB 630, collected by Mrs. Brooks in Edwards County, August, 1940; TEB 678A, Riley County, September 22, 1940.

Usually the sporangia are discoid or almost annulate, but collections are often partially or wholly composed of hemispheric sporangia. G. Lister (9) has separated the discoidal collections from typical B. affinis as var.

orbiculata. Macbride and Martin (10) considered B. affinis as having discoidal to subspherical sporangia and spores 16-17 mu in diameter, and B. orbiculata as having orbicular or discoidal sporangia and spores 12-14 mu in diameter. NYBG 2861, collected by Nagelstein in Pike County, Pennsylvania, was considered by him to be B. affinis. The spores of the Pennsylvania collection come well within the range of the Kansas specimens and differ in no detail from the hemispheric sporangia often found in those collections. If the discoidal phase is to be separated from B. affinis it should be considered no more than a variety as G. Lister has done.

3. Badhamia gracilis Macbride. Sporangia gregarious or crowded, stalked or occasionally sessile, subglobose to depressed globose, or somewhat irregular, usually umbilicate below, 0.2-0.5 mm in diameter, bluish gray or grayish white. Sporangium wall membranous, thin, fragile, colorless, with scanty clustered deposits of white lime granules, breaking irregularly. Stalk slender, membranous, yellow, straw colored, or reddish. Columella none. Capillitium a dense, delicate network of tubes with scanty deposits of white lime granules. Spores dark purple-brown in mass, dark purple-brown by transmitted light, globose, minutely and closely spinulose or nearly smooth, apparently marked with a coarse reticulation, 12-15 mu in diameter.

Common on dead stems of Opuntia, attached dead leaves of yucca, and occasionally on decaying sorghum plants. Kansas: TEB 358, Geary County, October 12, 1937; TEB 519, Geary County, August 7, 1938; TEB 660, Edwards County, August 4, 1940.

Hagelstein (5) stated that the spores when dry assume a polyhedral shape with many faces and edges, which, unless thoroughly wetted, will show shrinkage lines which may be mistaken for spore markings, but that when properly swollen the spores are globose with no reticulations. B. gracilis is readily distinguished from B. macrocarpa by the more delicate, almost limeless capillitium.

4. Badhamia macrocarpa (Ces.) Rost. Sporangia gregarious, stalked, occasionally sessile, subglobose, depressed globose, or reniform, 0.2-0.5 mm in diameter, grayish white to bluish gray in color. Sporangium wall membranous, fragile, colorless, with densely clustered deposits of white lime granules, dehiscing irregularly. Stalk slender, furrowed, yellow or straw colored, darker at the base. Hypothallus scanty. Columella none. Capillitium a network of slender or thick tubes with abundant deposits of white lime granules, often more densely developed at the center of the sporangium. Spores in mass black, dark purple-brown by transmitted light, globose, minutely or strongly and closely spinulose, usually marked with patches of darker spinules, often apparently irregularly reticulate, 11.7-14 mu in diameter.

Common on bark of dead boxelder trees, boxelder trimmings, and dead attached leaves of yucca. Kansas: E. F. Roberts 27, Riley County, spring of 1898; TEB 314, Geary County, June 27, 1937; TEB 440, Geary County, July 2, 1938; TEB 658, Geary County, July, 1937; TEB 716, Riley County, September 1, 1940.

TEB 656, collected in Riley County, Kansas, September 15, 1940, was identified by Hagelstein as B. macrocarpa. The sporangia are globose, stalked, and about 1 mm in diameter. The capillitium is composed of a

network of slender tubes densely charged with lime. The spores are purple-brown by transmitted light, globose to ovoid, closely spinulose, when globose 12.8-15 mu in diameter, when ovoid 9.4-14 x 14-17.8 mu.

5. Badhamia panicea (Fr.) Rost. Sporangia gregarious or crowded, sessile, globose, subglobose, 0.3-0.5 mm in diameter, or forming short simple plasmodiocarps up to 1.5 mm in length, grayish white, iridescent in the absence of lime, seated on a scanty dark red hypothallus, occasionally mounted on a short dark red stalk, dehiscing irregularly. Sporangium wall membranous, with dense clustered deposits of white lime granules above, almost limeless and reddish in color below. Columella none. Capillitium white, composed of a coarse or profuse network of slender or thick tubes charged with lime granules, often fused in the center of the sporangium to form a dense nucleate mass of lime, often with a few colorless threads present. Spores brown in mass, purplish brown by transmitted light, globose to somewhat ovoid, very minutely spinulose, 10-12 mu in diameter.

On dead wood and bark. Riley County, Kansas: TBB 651, September 15, 1940; TBB 652, collected by the author and Mrs. Brooks, September 22, 1940.

According to Lister (9) the capillitium is often confluent at the base and forming an ivory-white columella. Macbride and Martin (10) stated that a pseudocolumella often appears, formed by a dense development of the capillitium near the center and base of the sporangium. In the Kansas specimens no columella was evident, but the capillitium is often densely confluent in the center of the sporangium forming a nucleate mass of lime. Lister (9) described the spores as violet-brown and very

minutely warted, whereas Macbride and Martin (10) described them as bright violaceous brown and minutely punctate. The spores of the Kansas specimens are distinctly, but very minutely, spinulose and purplish brown in color.

Genus 3. Cienkowskia Rost.

Fructification forming netlike or effused plasmodiocarps, rarely globose sporangia. Capillitium abundant, composed of branching and anastomosing threads with free sicklelike branches.

1. Cienkowskia reticulata Rost. Plasmodiocarps terete, branched, vermiform, netlike, 0.3-0.4 mm in diameter, or forming perforated plates, rarely forming sporangia 0.2-0.3 mm in diameter, reddish brown, dehiscing irregularly leaving the orange-yellow to scarlet base. Sporangium wall membranous above, subcartilaginous below, orange or orange-yellow with scarlet waxy spots, marked by the edges of the transverse plates, and usually with dense clustered deposits of lime granules. Columella none. Hypothallus usually almost obsolete, occasionally composed of yellow to red membranous strands. Capillitium an elastic network of yellow-brown threads with free sicklelike branches, and transverse plates or branched tubes filled with yellow lime granules. Spores clear brownish violet or violet-brown by transmitted light, globose, minutely spinulose, 7.8-10 mu in diameter. Plasmodium orange-red.

Not uncommon on fallen twigs and branches. Kansas: TEB 238, Geary County, June 1, 1936; TEB 351, developed from an orange-red plasmodium, Geary County, September 6, 1937; TEB 357, Geary County, September 12, 1937; TEB 466, Riley County, August 18, 1938; TEB 650, collected by the

writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 740, Riley County, September 29, 1940.

Occasional fruitings occur which are entirely limeless. TEB 356 developed on September 11, 1937 from an orange-red plasmodium. The sporangium wall is limeless, scarlet, with concolorous waxy spots. The transverse plates are red-orange to scarlet and occasionally tinged with yellow. They are without deposits of lime granules, and when placed in 50 percent lactic acid the color diffused out into the lactic acid. In TEB 359 the plasmodiocarps are limeless. The sporangium wall is glossy brown with dull red waxy spots. The capillitial plates are scarlet-orange to scarlet-purple.

Genus 4. Physarella Peck

Sporangia stalked, shortly cylindric, deeply umbilicate, or forming irregular plasmodiocarps. Sporangium wall membranous with clustered deposits of lime granules. Capillitium composed of sparingly branched threads extending from the columella to the sporangium wall, interspersed with thick rodlike tubes densely filled with lime granules.

1. Physarella oblonga (Berk. & Curt.) Morgan. Sporangia gregarious, sometimes sessile, forming irregular plasmodiocarps, usually stalked, oblong, or irregularly expanded, deeply umbilicate above with the umbilicum continuous with the hollow stalk. Sporangium wall membranous, yellowish brown, with numerous or few densely clustered deposits of yellow lime granules, breaking at the apex and reflexing in petal-like lobes, the wall forming the umbilicum remaining as the columella. Stalk red, hollow, arising from a scanty hypothallus. Capillitium composed of sparingly

branched pale yellow threads radiating from the columella, interspersed with thick rod-like tubes densely filled with orange-yellow or yellow lime granules, in dehiscence remaining attached to the reflexed lobes of the sporangium wall. Spores in mass violet-brown, brownish violet by transmitted light, mostly globose, minutely spinulose or nearly smooth, 8.3-9.4 mu in diameter.

Not uncommon on dead wood. Kansas: H. F. Roberts, Riley County, June, 1898; TEB 474, Geary County, July 2, 1938; TEB 597, collected by the writer and Mrs. Brooks in Edwards County, August 1, 1940.

Genus 5. Craterium Trentepohl

Sporangia stalked or sessile, ovoid to cylindric, dehiscing by a more or less definite lid. Sporangium wall membranous, with deposits of lime granules. Capillitium a network of threads connecting lime knots, usually more densely developed towards the center of the sporangium to form a pseudocolumella.

Key to Species of Craterium

1. Sporangia yellow. . . . . 1. C. aureum.

1. Sporangia white above.

2. Sporangia turbinate to cylindric, dehiscing more or less regularly by a cap . . . . . 2. C. leucocephalum.

2. Sporangia turbinate or globose, dehiscing irregularly in the upper half. . . . . 2a. C. leucocephalum scyphoides.

1. Craterium aureum Rost. Sporangia gregarious, stalked, rarely sessile, ovoid, obovoid, globose, oblong, clavate, or urn-shaped, 0.2-0.3 mm in diameter, yellowish or greenish yellow, sometimes tinged with red, rarely tawny, fading to gray upon exposure. Sporangium wall membranous, with clustered deposits of yellow granules of lime, breaking at maturity in the upper part leaving a shallow cup, or falling away irregularly nearly to the base. Stalk 0.1-0.7 mm in length, furrowed, often twisted, translucent, yellow, often partly or completely red in color, with or without deposits of lime granules. Hypothallus yellow, membranous, scanty. Columella none. Capillitium more or less badhamoid, composed of yellow, angular or branching lime knots connected by colorless threads, usually more densely developed at the center of the sporangium to form a pseudo-columella. Spores dark violet-brown in mass, brownish violet by transmitted light, globose, warted or spinulose, 8.3-11 mu in diameter.

Common on dead leaves and twigs. Kansas: TEB 283, Geary County, June 21, 1937; TEB 438, Geary County, July 2, 1940; TEB 581, collected by Mrs. Brooks in Edwards County, June, 1940; TEB 698, collected by the writer and Mrs. Brooks in Riley County, August 25, 1940.

Recognized in the field by the small, stalked, yellow, droplet-shaped sporangia.

2. Craterium leucocephalum (Pers.) Ditm. Sporangia gregarious, stalked, cyathiform to cylindric, 0.5-1.0 mm in height, white above, orange-red to reddish brown below, occasionally entirely brown in the absence of lime, dehiscing more or less regularly by a cap. Sporangium wall single, cartilaginous, rough with deposits of white lime granules above, translucent and without deposits of lime at the base. Stalk

orange-red to reddish brown, from less than 0.1 mm to 0.3 mm in length, without deposits of lime or other refuse matter, mounted on a small circular concolorous hypothallus. Capillitium a network of slender colorless or yellow threads with large, angular, white lime knots, usually densely developed in the center of the sporangium to form a white or orange pseudocolumella. Spores in mass brown, violet-brown by transmitted light, globose, minutely spinulose to nearly smooth, 7.2-9.4 mu in diameter.

Common on decaying leaves and grass. Kansas: A. S. Hitchcock 38, Riley County, August 14, 1893; E. F. Roberts 37, Riley County, June, 1898; TEB 297, 297A, and 371, Geary County, June 20, 1937; TEB 453, Geary County, July 24, 1938; TEB 626, Riley County, August 17, 1940; TEB 745, Geary County, August 15, 1940; TEB 762 and 763, Riley County, June 15, 1940.

Intermediate forms between C. cylindricum Massee and C. leucocephalum occur so often that the former seems to be merely a phase of C. leucocephalum.

2a. Craterium leucocephalum scyphoides Lister. Sporangia turbinate to globose, 0.2-0.4 mm in diameter, white except for the reddish brown base. Sporangium wall breaking away irregularly in the upper half. Stalk orange-red, 0.2-0.4 mm in length. Spores 8.9-9.4 mu in diameter.

On decaying leaves, grass, and twigs. Kansas: TEB 430 and 491, Geary County, June 26, 1938.

Yellow crystalline bodies varying in diameter from 8-25 mu were found present superficially on the sporangium wall, and in the lime knots and pseudocolumella in TEB 297A and 453. They appear to be globose crystalloids composed of filiform crystals radiating from the center, and are easily detected by mounting the sporangia in xylol. The crystalline bodies were not found in any of the other collections examined.

Genus 6. Physarum Pers.

Fructification plasmodiocarpous, sporangiate, or occasionally subaethaloid. Sporangium wall single, or composed of two distinct layers, usually with deposits of lime granules. Capillitium intricate, a network of slender threads with vesicular expansions filled with lime granules. Capillitium intricate, a network of slender threads with vesicular expansions filled with lime granules (lime knots).

Key to Species of Physarum

1. Sporangium wall composed of a single layer.
 2. Plasmodiocarpous or sessile.
  3. Plasmodiocarps more or less laterally compressed.
   4. Yellow to orange-red in color. . . . . 1. P. superbum.
   4. Gray to olivaceous buff in color, forming labyrinthine plasmodiocarps. . . . . 2. P. gyrosum.
  3. Sporangia not laterally compressed.
   4. Spores ellipsoid or globose. . . . . 3. P. ovisporum.
   4. Spores globose, not ellipsoid.
    5. Sporangia white or gray.
     6. Spores violet-brown, warted. . . . . 4. P. cinereum.
     6. Spores dark purple-brown, strongly and closely spinulose. 5. P. vernum.
    5. Sporangia other than white or gray.
     6. Sporangia yellow to orange-red; lime knots yellow, often with a red center. . . . . 6. P. lateritium.
     6. Sporangia reddish brown; lime knots orange-red. 7. P. rubiginosum.

2. Sporangia stalked, or occasionally sessile.

3. Sporangia discoid or turbinate. . . . . 8. P. megalosporum.

3. Sporangia not discoid or turbinate.

4. Stalks containing deposits of lime granules.

5. Columella small, conic.

6. Sporangia white. . . . . 9. P. globuliferum.

6. Sporangia yellow or orange . . . . . 10. P. melleum.

5. Columella none.

6. Stalks 0.5-1.2 mm in length; spores 8.3-9.4 mu in diameter. 11. P. tenerum.

6. Stalks 1.5-2.2 mm in length; spores 9.4-11 mu in diameter. 12. P. maculatum.

4. Stalks without deposits of lime, usually containing refuse matter.

5. Sporangia usually laterally compressed. . . . 13. P. compressum.

5. Sporangia not laterally compressed.

6. Lime knots white.

7. Spores about 7 mu in diameter . . . . . 14. P. nucleatum.

7. Spores over 10 mu in diameter.

8. Stalks reddish, free of refuse matter. . . 15. P. pusillum.

8. Stalks nearly black, containing refuse matter. 16. P. nutans.

6. Lime knots yellow.

7. Sporangia subglobose or lenticular.

8. Sporangia yellow . . . . . 17. P. viride.

8. Sporangia gray or yellowish gray. . . . .17a. P. viride incanum.

7. Sporangia irregular in shape. . . . . 18. P. polycephalum.

7. Sporangia globose or subglobose, capillitium more or less badhamoid . . . . . 19. P. auriscalpium.

1. Sporangium wall composed of two distinct layers.

2. Plasmodiocarpous or sessile.

3. Lime knots brown. . . . . 20. P. aeneum.

3. Lime knots white, or yellowish.

4. Sporangia crowded, subglobose. . . . . 21. P. contextum.

4. Sporangia more or less laterally compressed.

5. Sporangia bilabiate. . . . . .22. P. bivalve.

5. Sporangia not bilabiate. . . . . 23. P. bitectum.

2. Sporangia stalked, occasionally sessile.

3. Stalks containing deposits of lime; sporangia white to orange in color. . . . . 24. P. listeri.

3. Stalks without deposits of lime, membranous; sporangia ovoid to cylindric. . . . . 25. P. didermoides.

1. Physarum superbum Nagelstein. Sporangia gregarious, sessile on a broad base, laterally compressed, forming irregularly branched or netted, straight or flexuose plasmodiocarps up to 10 mm in length, with interspersed subglobose, clavate, laterally compressed, or lobed sporangia, yellow to orange-red in color. Sporangium wall membranous, with dense or scanty deposits of lime granules, usually dense deposits above with scanty unevenly distributed deposits on the sides giving a mottled appearance, breaking along the apex of the plasmodiocarps. Hypothallus scanty, membranous, yellow. Columella none. Capillitium composed of white, yellowish, or pale orange, rounded, angular, or branched lime knots of various sizes connected by hyaline threads, often aggregated in the center to form large irregular masses of lime white to pale orange in color. Spores dark brown in mass, violet-brown or pale violaceous gray by transmitted light, globose, minutely spinulose or nearly smooth, wall with a thinner area of dehiscence, 7.8-10 mu in diameter.

Fruiting in large colonies on dead leaves. Abundant in Riley County during the fall of 1940. Kansas: TEB 243B, Riley County, June 27, 1937; TEB 562, Geary County, June 13, 1940; TEB 625, Geary County, August 18, 1940; TEB 634, Riley County, September 11, 1940; TEB 640, Riley County, September 15, 1940; TEB 668, collected by the writer and J. M. Koepper in Riley County, September 29, 1940; TEB 669, Riley County, September 29, 1940; TEB 708, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940.

2. Physarum gyrosum Rost. Sporangia gregarious, stalked or sessile, irregular, forming rosettelike or dense labyrinthine plasmodiocarps, often subaethalioid, strongly laterally compressed, gray to olivaceous buff in color, seated on strands of a more or less continuous orange hypothallus. Sporangium wall membranous with clustered deposits of white to yellowish lime granules, with patches clear of lime iridescent. Stalk dull red, formed by a strand of the hypothallus. Capillitium composed of a scanty or somewhat abundant network of delicate colorless threads and fusiform or irregular white or pale lime knots. Spores light brown in mass, violaceous brown by transmitted light, globose, nearly smooth to minutely warted, 8-10.5 mu in diameter.

Not uncommon in sweetpotato beds. Kansas: F. U. C. Agrelius 45, Harvey County, August 23, 1907; TEB 450, collected by O. H. Elmer in Leavenworth County, June 15, 1938; TEB 554, collected by O. H. Elmer in Riley County, June 5, 1940; TEB 555, Riley County, June 5, 1940.

Physarum gyrosum appears to be on the border line between the genera Physarum and Fuligo, the more intricate plasmodiocarps resembling somewhat the aethalia of Fuligo. This species is closely related to Physarum polycephalum Schw. but differs in always being sessile.

3. Physarum ovisporum G. Lister. Sporangia gregarious, sessile on a narrow base, subglobose to elliptical, often connected, 0.1-0.5 mm in diameter, or forming short, terete plasmodiocarps up to 1.5 mm in length, gray in color. Sporangium wall membranous, fragile, purple-brown in color, iridescent, minutely roughened with deposits of white lime granules with smoother areas where the lime is less abundant, when lime is absent dark purple-brown, glossy. Hypothallus scanty, colorless. Capillitium abundant; lime knots numerous, small, white, rounded, connected by colorless threads, sometimes aggregated in center of sporangium to form a pseudocolumella. Spores in mass black, dark purple-brown by transmitted light, either globose, 11.7-13.3 mu in diameter, or ellipsoid, then 10.6-12.2 x 13.3-15 mu, warted, often marked by a paler, smoother line of dehiscence.

Over a period of two weeks in the fall of 1940 several small colonies were collected on decaying stems of Phytolacca decandra. Riley County, Kansas: TEB 644, September 15, 1940; TEB 646, September 22, 1940.

Nagelstein collected several developments of a certain physarum on Long Island which he considered to be this species (5). His forms agree with the description and figures of P. ovisporum, except in the small size of the sporangia, the angular, branching lime knots, which are rounded in the typical form, and the much paler spores. He does not consider the differences as sufficient to regard these collections as other than P. ovisporum.

The only other recorded collections are from England and Switzerland. The specimens from Switzerland, collected and determined by Meylan, have globose spores 9 mu in diameter with no visible area of dehiscence (10).

This would seem to be more closely related to P. cinereum (Batsch) Pers.

The species as collected in Kansas agrees very closely with the description of the species, the only apparent differences being the smaller sporangia and the somewhat larger spores.

4. Physarum cinereum Pers. Sporangia gregarious or crowded, sessile on a narrow or broad base, globose, subglobose, or clavate, 0.1-0.5 mm in diameter, or forming short, simple or branching, terete, sometimes slightly laterally compressed, plasmodiocarps, white, gray, or glossy brown in absence of lime. Sporangium wall membranous, fragile, smooth or rugose, with abundant or scanty clustered deposits of white lime granules, breaking irregularly above, more persistent below. Hypothallus scanty or well developed, membranous, inconspicuous. Columella none. Capillitium often somewhat badhamoid, composed of numerous angular or branched white lime knots connected by slender, colorless threads usually forming a delicate network, often with a pseudocolumella or nucleate mass of lime. Spores brown in mass, violet-brown by transmitted light, globose, warted 8-12 mu in diameter.

Common in large fruitings on dead leaves, weed stems, and twigs. Kansas: W. A. Kellerman and W. T. Swingle 1382, Riley County, August 25, 1890; E. F. Roberts 48a, Riley County, Spring, 1898; F. U. G. Agrelius 57, Douglas County, November 3, 1906; TEB 316, Geary County, June 20, 1937; TEB 427, collected by D. B. Creager in Riley County, June 25, 1938; TEB 551, Geary County, June, 1940; TEB 611, Geary County, August 20, 1940; TEB 705, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940.

The spores in TEB 611 are purple-brown in color.

5. Physarum vernum Somm. Sporangia gregarious, clustered or scattered, depressed-globose, 0.4-0.7 mm in diameter, or forming depressed annulate, simple, or branched plasmodiocarpe, gray. Sporangium wall membranous, brittle, somewhat rugose, with abundant, more or less evenly distributed deposits of white lime granules, breaking irregularly. Columella none. Capillitium more or less badhamoid, composed of angular or branched white lime knots connected by colorless threads, usually more densely developed in the center to form an irregular pseudocolumella. Spores in mass dark purple-brown, dark purple-brown by transmitted light, globose, strongly and closely spinulose, 10.6-12.2 mu in diameter. Plasmodium dirty white or tan.

On bark moistened and kept in a moist chamber. Kansas: TEB 548, Geary County, June 23, 1940; TEB 548A, Geary County, June 29, 1940.

For the past few years American specimens approaching the description of P. vernum have been referred to P. cinereum. P. cinereum as it is generally understood has pale brownish violet spores 7-11 mu in diameter. What is perhaps a phase of the latter species has purple-brown spores which are warted and 11-12 mu in diameter. Nagelstein (6) recently described two specimens from the Atlantic Coast which he considered P. vernum. Although Nagelstein considered TEB 548 and 548A to be P. cinereum the specimens have been referred to as P. vernum because of the much darker, strongly marked spores.[3] The sporangia are not nearly so robust as an authentic specimen from Switzerland, and the spores are much darker.

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[3] Personal correspondence from Robert Nagelstein, June 6, 1940.

6. Physarum lateritium Morgan. Sporangia gregarious or crowded, sessile or very short stalked, subglobose, 0.2-0.5 mm in diameter, or forming short, terete plasmodiocarps up to 2 mm in length, yellow, orange to orange-red in color, fading to gray, dehiscing irregularly. Sporangium wall membranous, nearly colorless above, usually yellow or orange below, smooth or rugose, with scattered included clusters or occasionally abundant deposits of lime granules. Stalk when present very short, less than 0.1 mm in length, stout, white or orange in color, densely filled with lime granules. Columella none or occasionally small and conic. Capillitium a network of slender colorless threads connecting yellow lime knots occasionally with a red center, fading to nearly white, varying in size and shape, often forming a yellow or orange pseudocolumella. Spores brown in mass, pale violet-brown by transmitted light, globose, nearly smooth, marked with patches of minute warts, 8.3-9.4 mu in diameter.

Common on decaying leaves. Kansas: TEB 432, Geary County, July 2, 1938; TEB 494, Geary County, August 21, 1938; TEB 605, Fort Riley Reservation, August 21, 1940; TEB 635 and 636, collected by the writer and Mrs. Brooks in Riley County, September 11, 1940; TEB 642, Riley County, September 15, 1940; TEB 647 and 700, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 684, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940.

Specimens collected in 1938 were sent to Nagelstein. He reported the specimens as being intermediates between P. lateritium and P. rubiginosum Fries.[4] Martin regarded similar specimens as a pallid, sessile phase of P. melleum (Berk. & Br.) Massee.[5] All of the collections have

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[4] Personal correspondence from Robert Nagelstein, December 29, 1939.

[5] Personal correspondence from G. W. Martin, April 10, 1941.

a tendency to be stalked, the stalk being very short and containing deposits of lime granules.

7. Physarum rubiginosum Fries. Sporangia gregarious, sessile, occasionally globose but mostly consisting of short, branched or netted plasmodiocarps, reddish brown in color. Sporangium wall shiny, thin, membranous, fragile, with dense deposits of lime granules, rugose. Hypothallus somewhat extensive, membranous, lemon yellow in color. Columella none. Capillitium an abundant network of colorless threads connecting large angular lime knots which are orange-red, fading to nearly white. Spores dark brown in mass, violet-brown by transmitted light, globose, minutely spinulose and marked with patches of darker spines, 9-11 mu in diameter.

On dead leaves. Kansas: TEB 633, Riley County, September 11, 1940.

Typically P. rubiginosum occurs as gregarious or clustered, smooth or rugose, scarlet, reddish or olive-brown subglobose sporangia, with the capillitium an abundant network of hyaline threads connecting large, angular, branching, orange-red or red-brown lime knots, and spores pale violet-brown, minutely spinulose, 8-11 mu in diameter (9). Macbride and Martin (10) describe the spores as dull violaceous, faintly warted, 9-11 mu in diameter.

The above collection is poorly matured. Instead of being gregarious or clustered subglobose, the sporangia are united into irregular, straight or branching plasmodiocarps or clustered. The lime knots are red in color, fading to nearly white, but do not show a yellow color as in P. lateritium.

Closely related to P. lateritium, from which it differs in the redder, more angular lime knots.

8. Physarum megalosporum Macbride. Sporangia gregarious, stalked, occasionally sessile, turbinate, discoid, bolster shaped, or subglobose, usually umbilicate or at least depressed above, sometimes almost annulate, 0.2-0.5 mm in diameter, sometimes joined in twos on a single stalk, white above, brown or dark at the base, rarely lilaceous, dehiscing irregularly. Sporangium wall membranous, fragile, rugose or nearly smooth, under portion brown with granular matter or dark in the absence of lime, above with dense or sparse deposits of lime granules, with limeless patches iridescent. Stalk 0.3 mm or less in length, cylindric or tapering, wrinkled, brown to nearly black in color, sometimes gray, filled with lime granules and brown refuse matter, mounted on a dark veinlike or scanty hypothallus. Columella none. Capillitium composed of scanty colorless threads connecting the numerous, large, angular or branched, white lime knots, often more or less badhamoid. Spores in mass black, dark purplish brown by transmitted light, closely spinulose, with a pale, somewhat smoother area of dehiscence, 11-15 mu in diameter, averaging 13.4 mu.

This species fruited abundantly on decaying leaves in one locality. Geary County, Kansas: TEB 434, July 2, 1938; TEB 446, July 10, 1938; TEB 495, August 21, 1938; TEB 564, June 13, 1940. P. megalosporum has previously been collected only in Colorado.

Easily distinguished from Badhamia orbiculata by the physaroid character of the capillitium, and paler area of dehiscence on the spore.

9. Physarum globuliferum (Bull.) Pers. Sporangia gregarious or united in small clusters, stalked, globose, subglobose, or irregular,

0.2-0.5 mm in diameter, white in color. Sporangium wall thin, membranous, shiny, densely covered with clusters of white lime granules. Stalk flattened or cylindric, 0.3-0.6 mm long, often connected at the base in small clusters, white, yellowish to reddish brown in color, with lime deposits throughout. Columella small, conic, white or yellowish brown. Capillitium dense, persistent, with numerous small white, angular or rounded lime knots connected by short colorless threads. Spores in mass brown, pale brown by transmitted light, globose, warted, the warts in clusters, 8-9 mu in diameter.

On dead wood. Kansas: F. U. C. Agrelius 59, Douglas County, date unknown; TEB 442, Geary County, July 3, 1936.

10. Physarum melleum (Berk. & Br.) Massee. Sporangia gregarious, stalked, globose, 0.3-0.5 mm in diameter, pale yellow, brownish yellow, or orange in color. Sporangium wall membranous, fragile, yellow, somewhat iridescent, nearly smooth or rugose, with scanty, yellow or orange, clustered deposits of lime granules falling away irregularly above, leaving the more or less persistent base. Stalk 0.3-0.5 mm in length or shorter, tapering upwards, somewhat longitudinally furrowed, densely filled with white lime granules, rarely limeless, white or yellow in color, occasionally tawny or reddish brown, seated on a scanty, membranous hypothallus. Columella small, conic or hemispheric, white or yellow in color. Capillitium an abundant network of colorless threads connecting numerous angular or branching, white or yellow lime knots. Spores in mass brown, pale violet-brown by transmitted light, globose, minutely spinulose to nearly smooth, 7.8-8.3 mu in diameter.

Abundant from June to October on decaying leaves, or even fruiting on living leaves near the ground. Kansas: TEB 256, Geary County, October 18, 1936; TEB 302 and 308, Geary County, June 13, 1937; TEB 599, Geary County, June 13, 1940; TEB 686, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940; TEB 703, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 737, Geary County, August 15, 1940.

Readily recognized by the yellow or tawny sporangia on white or yellow stalks.

11. Physarum tenerum Rex. Sporangia gregarious, stalked, nodding, globose, 0.3-0.4 mm in diameter, yellow, fading to gray, usually dehiscing by petal-like lobes. Sporangium wall membranous, fragile, colorless, with deposits of yellow lime granules. Stalk slender, 0.5-1.2 mm in length, tapering from 60-100 mu at the base to 11-22 mu at the top, yellow, often dark at the base, slightly furrowed longitudinally, densely filled with yellow lime granules. Columella none. Capillitium a dense network of colorless threads, with numerous small, rounded, yellow lime knots. Spores brown in mass, pale violet-brown by transmitted light, globose, minutely warted to nearly smooth, 8.3-9.4 mu in diameter.

Not uncommon on dead wood. Kansas: F. U. G. Agrelius 44, Douglas County, September 13, 1906; F. U. G. Agrelius 77, Douglas County, June 10, 1909; TEB 436, Geary County, July 2, 1938; TEB 444, Geary County, July 3, 1938.

12. Physarum maculatum Macbride. Sporangia gregarious, stalked, depressed globose, 0.2-0.3 mm in diameter, pale yellow or gray in color. Sporangium wall membranous, fragile, with clustered deposits of lime

granules. Stalk 1.5-2.2 mm in length, tapering from about 100 mu at the base, to about 20 mu in diameter at the tip, yellow to reddish in color, filled with lime granules. Columella none. Capillitium consisting of a network of colorless threads connecting small, rounded or angular, yellow lime knots. Spores brown in mass, violet-brown by transmitted light, globoso, nearly smooth, with minute warts irregularly distributed in patches, 9.4-11 mu in diameter.

TEB 523, collected on wood in Geary County, Kansas, October 4, 1938.

Lister (9) and Nagelstein[6] have considered this to be merely a phase of P. tenerum Rex. Martin verified the identification of this collection stating that the collection is closer to P. maculatum than to P. tenerum, that the spores are a trifle small and that the few larger warts are less clustered than in the typical material.[7] Macbride and Martin (10) have retained the form because the habit and external appearance are different from P. tenerum, the stalk being notably long and clumsy.

13. Physarum compressum Alb. & Schw. Sporangia gregarious or somewhat scattered, stalked, reniform, subglobose, usually laterally compressed, or forming netlike plasmodiocarps up to 10 mm across, gray, glossy brown in absence of lime, dehiscing irregularly. Sporangium wall membranous, fragile, pale purplish brown, somewhat iridescent, mottled with numerous, small clustered deposits of white lime granules. Stalk 0.2-1.2 mm in length, slightly tapering upwards, furrowed longitudinally, grayish brown or dark brown in color, containing refuse matter. Hypothallus scanty.

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[6] Personal correspondence from Robert Nagelstein, May 6, 1940.

[7] Personal correspondence from Dr. G. W. Martin, March 30, 1940.

Columella none. Capillitium composed of numerous small rounded, or fusiform lime knots white in color and connected by colorless threads, in the center often forming a conspicuous pseudocolumella. Spores dark purple-brown in mass, dark purple-brown by transmitted light, globose or subglobose, strongly spinulose, 10.6-11.7 mu in diameter.

Not uncommon on fallen stems of giant ragweed. Kansas: TEB 393, developed on stems of giant ragweed collected in Geary County and cultured in a moist chamber, February 19, 1938; TEB 578, collected by Mrs. Brooks in Edwards County, June 1940; TEB 649, Riley County, September 22, 1940; TEB 713, Riley County, September 1, 1940.

14. Physarum nucleatum Rex. Sporangia gregarious, stalked, erect, globose, 0.2-0.4 mm in diameter, white. Sporangium wall fragile, membranous, with scattered clusters of white lime granules, iridescent in absence of lime, falling away irregularly, more persistent near the base. Stalk 0.5-0.8 mm long, nearly cylindrical, deeply furrowed, pale buff to reddish orange, often darker near the base, without lime deposits. Capillitium dense, persistent, with small, numerous, rounded, pale yellowish tan lime knots connected by short colorless threads, in the center of the sporangium usually fusing to form a conspicuous shiny, tan pseudocolumella. Spores pale viole-brown by transmitted light, globose, minutely spinulose, about 7 mu in diameter.

TEB 360, collected on bark in Geary County, Kansas, September 11, 1937.

In certain respects this description does not agree with that of other writers, but these differences are small and unimportant. Throughout this collection the lime knots, instead of being white in color, are

pale yellowish tan and somewhat translucent. Macbride and Martin (8) record the color of the spore mass as black, but in Kansas collections the color of the spore mass is noticeably lighter.

15. Physarum pusillum Lister. Sporangia gregarious, stalked, somewhat hemispheric, slightly umbilicate below, 0.3-0.6 mm in diameter, gray in color, dehiscing irregularly. Sporangium wall membranous, fragile, with small scattered clusters of white lime granules, iridescent in absence of lime, below reddish in color. Stalk terete to flattened, furrowed, corneous, without deposits of lime, reddish, dark at the base, seated on a scanty dark hypothallus. Columella none. Capillitium consisting of an abundant network of colorless threads connecting white lime knots of various sizes and shapes. Spores brown in mass, violet-brown by transmitted light, mostly globose, minutely warted, 10-12 mu in diameter.

Not uncommon on decaying weeds and grasses. Kansas: TEB 423A, Geary County, June 26, 1938; TEB 659 and 661, collected on sorghum used to thatch a shed in Edwards County, August 4, 1940; TEB Riley County, August 1, 1940; TEB 771, Geary County, June 13, 1940.

16. Physarum nutans Pers. Sporangia gregarious, stalked or sessile, globose or lenticular, 0.2-0.7 mm in diameter, gray or white, or iridescent in absence of lime, dehiscing irregularly. Sporangium wall membranous, fragile, with abundant or scanty clustered deposits of white lime granules. Stalk stout, furrowed, dark brown or nearly black color, opaque, containing refuse matter. Columella inconspicuous or obsolete. Capillitium a dense network of colorless threads with few small or large, angular or branched, white lime knots. Spores brown in mass, violaceous brown by transmitted light, globose, minutely warted and marked with clusters of darker warts, 10-14 mu in diameter.

On decaying leaves and twigs. Kansas: F. U. C. Agrelius 42 and 43, Douglas County, September 12, 1906; TEB 582, collected by Mrs. Brooks in Edwards County, June, 1940; TEB 657, Edwards County, August 4, 1940; TEB 735, Saline County, August 22, 1940; TEB 772, Riley County, September 29, 1940.

17. Physarum viride (Bull.) Rost. Sporangia gregarious, stalked, nodding, subglobose or lentioular, 0.3-0.5 mm in diameter, yellow. Sporangium wall membranous, above with small clustered deposits of yellow lime granules, below without deposits of lime, breaking into fragments. Stalk tapering upwards, furrowed, opaque from included refuse matter except below, nearly colorless above, without deposits of lime. Columella none. Capillitium composed of colorless threads arising from the base of the sporangium, branching and anastomosing to form a dense network, with yellow fusiform lime knots. Spores brown in mass, grayish or violaceous brown by transmitted light, globose, minutely spinulose and marked with patches of darker spinules, 8.3-9.4 mu in diameter.

Common on dead wood. Geary County, Kansas: TEB 246A, March 30, 1936; TEB 246B, June 20, 1937.

17a. Physarum viride incanum Lister. Sporangia gray or yellowish gray in color, lime knots pale yellow.

Common on dead wood. Kansas: H. F. Roberts 52, Riley County, August 14, 1897; TEB 264, Geary County, March 30, 1936; TEB 693, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940.

18. Physarum polycephalum Schwein. Sporangia gregarious, stalked, irregular, yellow or gray in color. Sporangium wall thin, fragile, membranous, with scanty clustered deposits of white lime granules, falling

away irregularly above leaving a more persistent base. Stalks slender, tapering, twisted, often fasciculate, tawny, translucent. Hypothallus thin, membranous, colorless, continuous. Columella none. Capillitium composed of a loose network of colorless threads connecting lime knots which are yellow, fading to white, and vary much in size and shape. Spores brown in mass, pale violet-brown by transmitted light, globose, minutely warted, 9.4-10.6 mu in diameter.

Frequently observed forming extensive colonies on wood. Kansas: F. U. C. Agrelius 42, Douglas County, September 12, 1906; F. U. C. Agrelius 47, Lyons County, the fall of 1911; TEB 331, Geary County, July, 1937.

In TEB 331 the spore mass tends to extend into the membranous stalks. When that is the case a platelike, reddish brown columella extends from the base well into the spore mass. This condition apparently has not been previously reported.

19. Physarum auriscalpium Cooke. Sporangia gregarious to crowded, sessile on a narrow base or stalked, globose, subglobose, or forming short plasmodiocarps, yellow, with a brown base, fading to gray. Sporangium wall membranous, with clustered deposits of lime granules. Stalk 0.2 mm or shorter in length, reddish brown, opaque, without deposits of lime, seated on a scanty dark hypothallus. Columella none. Capillitium more or less badhamoid, consisting of large, branching, yellow lime knots connected by colorless threads. Spores light brown in mass, gray by transmitted light, globose, minutely warted, 10-11 mu in diameter.

A single collection found by F. U. C. Agrelius on bark of cottonwood log in Harvey County, Kansas, August 23, 1907.

Dr. Martin regarded this as Badhamia decepiens (Curtis) Berk.,[8] whereas Mr. Hagelstein regarded it as P. auriscalpium.[9]

20. Physarum aeneum Fries. Sporangia gregarious, sessile on a narrow or broad base, subglobose, 0.2-0.3 mm in diameter, or forming short, flexuose, or branching slender, terete plasmodiocarps, 0.2-0.3 mm in diameter, tan or olive-brown, glossy, dehiscing irregularly along the apex. Sporangium wall of two distinct layers, the outer layer thin, cartilaginous, rugose, brown with deposite of lime granules, smooth and glossy on the outside, rough with deposits of lime granules on the inside, usually separate or easily separable from the thin, colorless, iridescent, membranous inner layer. Hypothallus somewhat continuous, thin, brown. Columella none. Capillitium a network of colorless threads connecting small, rounded or angular, tan or brown lime knots. Spores pale brownish lilac by transmitted light, globose to ovoid, minutely warted or nearly smooth, 7.8-9.4 mu in diameter, averaging 8.3 mu.

On dead grass stems and bark of living trees. Kansas: TEB 292, Geary County, June 13, 1937; TEB 406, developed March 1, 1938 on bark collected in Geary County and cultured in a moist chamber; TEB 542, developed April 23, 1940 from a tan plasmodium on bark collected in Riley County and cultured in a moist chamber; TEB 566, developed June 25, 1940 on bark collected in Geary County and cultured in a moist chamber.

Until within the last few years this species has not been found outside of the tropics. During 1938 Martin obtained the species from cultures

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[8] See footnote 5, p. 36.

[9] Personal correspondence from Robert Hagelstein, March 6, 1940.

of bark of living trees. Apparently the only other collection from North America is a specimen consisting of a few scattered sporangia on a single leaf found in Virginia by R. H. Rispaud in August, 1939 (8).

Typically the sporangium wall of P. aeneum is double, the two layers usually being widely separated. In TEB 406 the sporangium wall appears to consist of a single layer, but the collection agrees in all other respects with the description. The sporangium wall of TEB 568 is shiny gray in color.

21. Physarum contextum Pers. Sporangia gregarious or crowded, sessile on a broad base, flattened above, subglobose, 0.3-0.4 mm in diameter, or forming simple plasmodiocarps up to 1.5 mm in length, yellow, buff, ochraceous, pale orange, or white in color. Sporangium wall double, the outer layer with thick deposits of lime granules which usually break away from the colorless, iridescent, membranous inner layer. Columella none. Capillitium a network of short, colorless, iridescent threads connecting white or yellowish lime knots varying in size and shape, angular or branching, sometimes aggregated in the center to form a pseudocolumella. Spores dark purple-brown in mass, purple-brown by transmitted light, globose, strongly or minutely warted, 11-14 mu in diameter.

Occasionally abundant on decaying leaves and moss. Kansas: TEB 243, Geary County, July 4, 1937; TEB 622, Geary County, August 19, 1940; TEB 702, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 733, Riley County, September, 1940.

22. Physarum bivalve Pers. Sporangia gregarious, sessile on a narrow base, laterally compressed, the sides nearly parallel from the base to the apex, forming branched, annulate, or straight to flexuose, simple plasmodio-

carps up to 14 mm or more in length, occasionally interspersed with cylindric sporangia, white, gray, light grayish brown, or buff in color. Sporangium wall composed of two layers, the outer layer subcartilaginous, with deposits of lime granules smooth, or unevenly distributed giving a mottled appearance, splitting longitudinally along the upper ridge and reflexing, except at the upper ridge adhering to the inner layer which is a colorless, iridescent, fragile membrane. Hypothallus scanty, membranous. Columella none. Capillitium abundant, consisting of numerous small, shiny, angular or branching white lime knots connected by short colorless threads. Spores brown in mass, violet-brown by transmitted light, sometimes pale violet-brown, globose, minutely spinulose to nearly smooth, 9-10.5 mu in diameter.

Abundant on leaves from June to November. Kansas: TEB 259, Geary County, November 29, 1936; TEB 688 collected by the writer and Mrs. Brooks in Riley County, September 29, 1940; TEB 744, Geary County, August 15, 1940.

Differing from P. bitectum Lister in the smaller, paler, smoother spores without a paler area of dehiscence, and the fragile, colorless inner layer, and from P. borginense Racib. in the minutely spinulose, darker spores, and the sporangium wall not dehiscing into areolae.

23. Physarum bitectum Lister. Sporangium gregarious, sessile on a narrow base, sometimes pyriform, 0.3-0.5 mm in diameter, usually forming straight, curved, or irregularly branched plasmodiocarps, rounded or laterally compressed, up to 4 mm in length, white. Sporangium wall consisting of two layers, the outer layer with dense deposits of white lime granules, sometimes naked and dark brown below, above free from the inner layer and irregularly dehiscent, below persistent; inner layer membranous,

dark purple-brown or nearly colorless, on the inside shiny, the outside with scanty deposits of white lime granules, somewhat iridescent. Hypothallus scanty, membranous. Columella none. Capillitium composed of numerous large, angular or branching, white lime knots connected by hyalin threads, sometimes aggregated to form a large pseudocolumella. Spores dark brown or nearly black in color, dark purplish brown or dark brown by transmitted light, strongly spinulose with a pale violet, nearly smooth area of dehiscence, 10-13 mu in diameter.

Not uncommon on decaying leaves. Kansas: TEB 305, Geary County, June 20, 1937; TEB 573 and 574, collected by Mrs. Brooks in Edwards County, June, 1940; TEB 704, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940.

Related to P. bivalve from which it differs in the larger, darker, more strongly spinulose spores with a paler area of dehiscence, not being bilabiate, and in the inner wall usually being purple-brown.

24. Physarum listeri Macbride. Sporangia gregarious, stalked, subglobose, depressed globose, or hemispheric, usually plane or slightly umbilicate below, 0.2-0.7 mm in diameter, ranging from nearly white to reddish orange in color, usually some shade of yellow, often mounted in twos on a single stalk. Sporangium wall distinctly consisting of two layers, the outer layer cartilaginous, yellow or orange in color, with dense or scanty deposits of yellow lime granules, rarely entirely free of lime, smooth or rugose, shiny, opaque except near the base where it is sometimes translucent, usually, at least above, dehiscing along slightly darker, raised, predetermined lines into areolae, reflexing and separating away from the inner layer, remaining as a persistent collar

at the base; inner layer membranous, fragile, with deposits of white lime granules, breaking irregularly. Stalk 0.5-1.0 mm in length, stout, cylindric on a thickened base or tapering toward the base, occasionally laterally flattened, usually orange above, nearly white below, occasionally almost entirely orange, rarely light brown in color, densely charged with white granules of lime, lime often absent at the base, rarely entirely absent, often united in twos or threes at the base, or the sporangia and stalks coalescing. Hypothallus scanty, membranous. Columella large, yellow or orange in color, hemispheric, subglobose, conic, oblong, narrowly or broadly clavate, or irregular in shape, occasionally laterally flattened, sometimes with stout processes extending nearly to the sporangium wall. Capillitium scanty, persistent after spore dispersal, consisting of hyaline threads radiating from the columella, branching and anastomosing to form a loose network; lime knots yellow, varying in size and shape, filiform, rounded, angular or branched, sometimes consisting merely of a row of lime granules. Spores in mass dark brown to black, dark violet-brown by transmitted light, globose to ovoid, strongly spinulose, body of spore 10.6-11.7 mu in diameter.

This species appeared abundantly on decaying leaves during the fall of 1940. Riley County, Kansas: TEB 663, collected by the writer and Mrs. Brooks, September 22, 1940; TEB 662, 663 and 664, September 29, 1940; TEB 685, collected by the writer and Mrs. Brooks, September 29, 1940; TEB 707, collected by the writer and Mrs. Brooks, September 22, 1940. Previously reported in America from Colorado, Virginia, and Quebec (7).

25. Physarum didermoides (Ach.) Rost. Sporangia gregarious or crowded, stalked or sessile, ovoid to cylindric, or irregular in shape, 0.3-0.5 mm in diameter, white, gray when the outer layer has fallen off.

Sporangium wall apparently composed of two layers, the outer layer a crust of lime granules, subcartilaginous. Stalk white, membranous, without lime granules or refuse matter, arising from a continuous hypothallus with dense deposits of white lime granules. Columella none. Capillitium composed of numerous small, rounded, white lime knots connected by short colorless threads, often fused in the center to form a pseudocolumella. Spore in mass black, dark purple-brown by transmitted light, globose, olosely and minutely spinulose 11.7-14 mu in diameter.

Common on the bark of cottonwood and boxelder trunks and logs. Geary County, Kansas: TEB 32, April 13, 1936; TEB 400, developed on bark in a moist chamber, February 5, 1938; TEB 496, July 24, 1938.

Genus 7. Diderma Persoon

Sporangia scattered, gregarious, or crowded, sessile or stalked, or forming plasmodiocarps. Sporangium wall composed of two layers, the outer layer fragile, with dense deposits of lime granules, or cartilaginous, separate from or olosely adhering to the membranous inner layer. Capillitium composed of simple or sparingly branched slender threads without deposits of lime.

Key to Species of Diderma

1. Outer sporangium wall cartilaginous. . . . . 1. D. floriforme.

1. Outer sporangium wall composed of dense deposits of lime granules, fragile.

2. Sporangia forming more or less effused plasmodiocarps. 1. D. effusum.

2. Sporangia more or less distinct.

3. Hypothallus scanty or none; columella scanty or obsolete.

4. Sporangia sessile, subglobose to depressed-globose. 3. D. testaceum.

4. Sporangia stalked or sessile, discoid . . . . . 4. D. hemisphaericum.

3. Hypothallus well developed; columella conspicuous.

4. Columella white; sporangia sessile, crowded.

5. Spores 12-14 mu in diameter. . . . . 5. D. crustaceum.

5. Spores about 9 mu in diameter. . . . . 6. D. spumarioides.

4. Columella brown; sporangia short stalked or sessile. 7. D. lyallii.

1. Diderma floriforme Pers. Sporangia gregarious, stalked, globose, 0.5-0.8 mm in diameter, ochraceous brown. Sporangium wall composed of two layers, the outer layer cartilaginous, opaque, with dense deposits of lime granules, closely adhering to the membranous inner layer, reflexing by petal-like lobes. Stalk 0.5-1.0 mm in length, brown, furrowed, arising from a continuous red hypothallus without lime deposits. Columella conspicuous, clavate, ochraceous to brown, with dense deposits of lime granules. Capillitium abundant, composed of slender gray or brown threads thicker at the base and branching to form a loose net, marked with numerous beadlike thickenings. Spores dark brown in mass, brownish violet by transmitted light, mostly globose, sparsely marked with prominent blunt spines, 9.4-11 mu in diameter.

On dead wood. Collected by F. U. C. Agrelius in Douglas County, November 10, 1906.

2. Diderma effusum (Schw.) Morgan. Sporangia forming thinly effused plasmodiocarps, often perforated, reaching 2 cm in extent, grayish white. Sporangium wall composed of two layers, the outer layer fragile, with

dense deposits of white granules, smooth, adhering closely to the membranous inner layer and breaking with the outer wall into fragments. Hypothallus nearly obsolete. Columella composed of scanty deposits in the base of the sporangium. Capillitium an abundant network of slender, colorless, parallel threads which near the extremities are often branched and connected by expanded horizontal bars. Spores in mass brown, pale brown by transmitted light, irregularly globose, minutely warted and usually marked with patches of darker warts, about 7 mu in diameter.

On dead leaves. Kansas: TEB 623, Geary County, August 18, 1940; TEB 695 and 696, Riley County, August 23, 1940.

3. Diderma testaceum (Schrad.) Pers. Sporangia gregarious, sessile, depressed-globose or subglobose, slightly depressed above, 0.5-0.8 mm in diameter, or forming short depressed plasmodiocarps, ochraceous to nearly white. Sporangium wall composed of two layers, the outer smooth, brittle, with dense deposits of lime granules, easily separating from the thin, membranous inner layer which is usually grayish from scanty deposits of lime. Hypothallus none. Columella pulvinate, rough, ochraceous to brown in color. Capillitium abundant, composed of sparingly branched, pale or colorless threads often with calcareous thickenings. Spores in mass brown, brownish violet by transmitted light, globose, minutely warted, 9-10.6 mu in diameter.

Not uncommon on dead leaves. Kansas: H. P. Roberts 14, as Chondrioderma testaceum (Schr.) Rost., Riley County, August 16, 1897; TEB 666, Riley County, September 29, 1940; TEB 728, collected by Mrs. Brooks in Riley County, November 3, 1940; TEB 755, Riley County, August 19, 1940.

These collections may possibly be weathered D. effusum. The sporangia are more depressed than is usual for D. testaceum, and are not rose colored.

4. Diderma hemisphaericum (Bull.) Hornem. Sporangia gregarious or scattered, stalked or sessile, discoid, 0.5-0.1 mm in diameter, or forming short plasmodiocarps, white. Sporangium wall of two layers, the outer layer with dense deposits of white lime granules, smooth, fragile, adhering loosely above to the membranous inner layer which is flesh colored or brown at the base. Stalk short, furrowed, white, containing dense deposits of lime. Columella none. Capillitium abundant, composed of seldom branching, parallel, colorless threads extending from the base to the top of the sporangium. Spores in mass brown, brownish violet by transmitted light, mostly globose, minutely spinulose and marked with patches of stronger and darker spinules, 9-11 mu in diameter.

Not uncommon on decaying leaves, twigs, etc. Kansas: F. U. C. Agrelius 51, Harvey County, August 23, 1907; F. U. C. Agrelius 54, Douglas County, June 15, 1910; TEB 380, developed January 25, 1938 on bark of a living tree collected in Geary County; TEB 445, Geary County, July 10, 1938; TEB 593, Geary County, June 13, 1940; TEB 718, Riley County, September 1, 1940.

5. Diderma crustaceum Peck. Sporangia closely crowded on a white hypothallus, often superimposed, angular by mutual pressure, 0.4-0.7 mm in diameter, grayish white or white in color. Sporangium wall composed of two separate layers, the outer layer smooth, fragile, with evenly distributed deposits of white granules of lime, distant from the thin membranous inner layer which is colorless, iridescent, and often with

scanty deposits of lime. Columella conspicuous, white, globose or irregular. Capillitium not abundant, composed of violet or nearly colorless threads branching to form a loose network. Spores in mass dark violet-brown, violet-brown by transmitted light, globose, strongly and closely spinulose, 12.2-14 mu in diameter.

On dead leaves and twigs in extensive cushion-shaped colonies. Kansas: as Chondrioderma globosum (Pers.) Rost. collected by the Botanical Club of the Kansas State Agricultural College, Pottawatomie County, August 1, 1893; A. S. Hitchcock 12, as C. globosum, Riley County, August 14, 1893; TEB 608, Geary County, August 21, 1940.

6. Diderma spumarioides Fries. Sporangia gregarious or crowded, sessile on a white calcareous hypothallus, subglobose, 0.3-0.5 mm in diameter, white. Sporangium wall composed of two layers, the outer strongly calcareous, loosely adhering to the membranous inner layer which is less strongly calcareous. Columella white, conic, or almost obsolete. Capillitium abundant, composed of sparingly branched, slender, brown threads pale at the tips. Spores brown in mass, clear violet-brown by transmitted light, globose, distinctly spinulose, about 9 mu in diameter.

On dead leaves. TEB 775, collected in Geary County, Kansas, August 7, 1938.

7. Diderma lyallii Macbride. Sporangia gregarious or somewhat clustered, short stalked, globose, 0.5-0.7 mm in diameter, liliaceous white. Sporangium wall composed of two distinct layers, the outer layer firm, wrinkled, with dense deposits of white lime granules, mottled on the inner surface with flesh colored spores, easily separating from the delicate, colorless, iridescent, membranous inner layer which at the

base is attached to the base of the projected columella. Stalk white, wrinkled, continuous with the conspicuous white calcareous hypothallus. Columella subglobose, rough, brown, projected towards the center of the sporangium on a slender stalk. Capillitium abundant, composed of slender, branching brown threads with colorless tips. Spores brown in mass, violet-brown by transmitted light, subglobose, divided into two unequal halves by a pale line, strongly spinulose, 9.4-10.6 mu in diameter.

TEB 641, collected on leaves in Papaw Glen, Riley County, Kansas, September 15, 1940.

Hagelstein considered this collection an intermediate between D. niveum (Rost.) Macbr. and D. lyallii, but more closely related to the latter species.[10] The distinctive spores separate the collection from either species. Martin considered this an undescribed species.[11]

FAMILY DIDYMIACEAE

Fructification aethalioid, plasmodiocarpous, or sporangiate. Sporangium wall single or double, with deposits of lime in the form of stellate crystals or large superficial plates. Capillitium composed of slender, simple or branched threads without deposits of lime.

KEY TO GENERA OF DIDYMIACEAE

1. Fructification aethalioid. . . . . 8. Mucilago.

1. Fructification plasmodiocarpous or sporangiate; deposits of lime usually in the form of stellate crystals . . . 9. Didymium.

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[10] Personal correspondence with Robert Hagelstein, October 3, 1940.

[11] Personal correspondence with Dr. C. W. Martin, March 20, 1941.

Genus 8. Mucilago Adanson

Sporangia confluent to form aethalia, the whole of which is covered with a foamlike crust composed of stellate crystals of lime. Sporangium wall membranous. Capillitium composed of slender somewhat branched threads not usually containing deposits of lime.

1. Mucilago spongiosa (Leyss.) Morgan. Aethalia composed of compressed grayish white sporangia, seated on a well-developed membranous hypothallus, covered with a foamlike crust composed of stellate crystals of lime, reaching 4 cm in length and 1.5 cm in width. Sporangium wall membranous, colorless, covered with thin deposits of lime crystals, iridescent in absence of lime. Columella poorly developed or none, membranous. Capillitium a network of slender, branching and anastomosing brown threads pale at the extremities, often with dark thickenings, occasionally with vesicles enclosing a lime nodule. Spores dark brown in mass, violaceous by transmitted light, globose, strongly spinulose, 11-13 mu in diameter.

Common on dead leaves. Often found fruiting on stems of shrubs and high on the trunks of trees. TEB 687, collected by the writer and Mrs. Brooks, Riley County, Kansas, September 29, 1940.

1a. Mucilago spongiosa solida Lister. Capillitium composed of sparingly branched colorless threads. Spores violaceous brown, spinulose, 9.4-13 mu in diameter.

Kansas: TEB 335, Riley County, June, 1937; TEB 658, collected by Miss M. L. Gifford in Edwards County, August, 1940.

Genus 9. Didymium Schrad.

Sporangia gregarious or crowded, sessile or stalked, or forming plasmodiocarps. Sporangium wall membranous, covered with dense or scanty deposits of crystals of lime, or composed of two layers, the outer a compact layer of lime crystals, and the inner layer membranous. Capillitium composed of slender threads, single or branching and anastomosing, without deposits of lime.

Key to Species of Didymium

1. Sporangium wall of two layers, the outer a densely compacted layer of lime crystals easily separating from the purple-brown inner layer. 1. D. difforme.

1. Sporangium wall membranous, sprinkled with dense or scanty deposits of lime crystals.

2. Plasmodiocarpous or sessile.

3. Dehiscence tending to be circumscissile. . . . . 2. D. anellus.

3. Dehiscence irregular.

4. Columella conspicuous, laterally flattened. . . 3. D. parietale.

4. Columella not laterally flattened, inconspicuous or obsolete.

5. Capillitium of simple parallel threads connected by horizontal bars. . . . . 4. D. listeri.

5. Capillitium threads more or less branching.

6. Capillitium composed of stout, dark purple-brown threads which form a rigid, somewhat elastic network . . . 5. D. rigidum.

6. Capillitium forming a loose network.

7. Sporangia ochraceous to nearly white, pulvinate or depressed. 6. D. ochroideum.

7. Sporangia subglobose or forming netlike plasmodiocarps. 7. D. squamulosum.

2. Stalked or occasionally sessile.

3. Sporangia discoid. . . . . 8. D. olavus.

3. Sporangia globose, subgloboso, or lenticular.

4. Stalk containing dense deposits of lime.

5. Stalk and columella pale brown. . . 12a. D. melanospermum bicolor.

5. Stalk and columella usually white, not pale brown. 7. D. squamulosum.

4. Stalk without included deposits of lime.

5. Columella yellow, discoid, rough or spiny. . . 9. D. eximium.

5. Columella white or pale . . . . . 10. D. xanthopus.

5. Columella dark.

6. Columella small, conic . . . . . 11. D. nigripes.

6. Columella conspicuous, subglobose.

7. Spores 9-13 mu in diameter. . . . . 12. D. melanospermum.

7. Spores 8-9 mu in diameter . . . . . 13. D. minus.

1. Didymium difforme Duby. Sporangia scattered, pulvinate on a broad base, or forming short pulvinate plasmodiocarps, 0.2-4 mm long, smooth and white. Sporangium wall of two separate layers, the outer layer a densely compacted layer of calcareous crystals, not connected to the substrate, smooth, white in color, lifting entire or breaking irregularly, easily separating from the delicate, iridescent membranous inner layer which is purplish above, thickened and yellowish brown or purple-brown below. Base of sporangium an orange membrane with scanty deposits of lime crystals. Hypothallus none. Capillitium scanty, consisting of irregular, brown threads branching sparingly at either extremity, arranged vertically, dark brown beadlike swellings often present. Spores bluish black in mass, dark

brown by transmitted light, globose, densely and minutely spinulose or nearly smooth, paler and smoother on one side, 12-14 mu in diameter.

Occasionally in abundance on dead leaves and twigs. Kansas: TEB 321, Geary County, July 4, 1937; TEB 609, collected in abundance by the writer and C. C. Epps in Saline County, August 22, 1940; TEB 661, collected by the writer and J. M. Koepper in Riley County, September 29, 1940.

Often described as Diderma because of the smooth, calcareous outer wall. Nearly always, however, at least a few stellate crystals of lime may be found along the broken edges of the wall.

2. Didymium anellus Morgan. Sporangia scattered, sessile or rarely on a short black stalk, pulvinate, often slightly depressed above, 0.3-0.7 mm in diameter, or forming slender, annulate or flexuose plasmodiocarps, gray, glossy brown in absence of lime; dehiscence circumscissile. Sporangium wall membranous, yellowish or nearly colorless, frosted with scanty deposits of stellate lime crystals. Capillitium abundant, of slender brown threads connected laterally and branching to form a loose net; small colorless or brown swellings usually present. Columella none. Spores in mass brown, grayish brown by transmitted light, globose, minutely warted, warts irregularly arranged, 9-11 mu in diameter, averaging 10 mu.

On leaves and twigs throughout the season. Probably not uncommon but seldom collected because of the resemblance to D. squamulosum as well as the inconspicuous fruiting. Kansas: TEB 337, Geary County, July 18, 1937; TEB 569, Geary County, June 13, 1940; TEB 576, collected by Avis Clifford in Edwards County, June, 1940; TEB 601, Geary County, August 20, 1940; TEB 623A, Riley County, August 17, 1940; TEB 683, collected by the

writer and Mrs. Brooks in Riley County, September 29, 1940; TEB 684, collected by the writer and J. Hudspeth in Geary County, August 18, 1940; TEB 701, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 712, collected by the writer and Mrs. Brooks in Riley County, August 22, 1940; TEB 723, Riley County, June 10, 1940.

Closely resembling some plasmodiocarpous phases of D. squamulosum, but easily recognized by the circumscissile dehiscence. As the species occurs in Kansas it is remarkably constant in capillitium and spore characteristics, and differs only in the amount of lime present and the shape of the sporangia. As found by Nagelstein (4) on Long Island the species seems to be extremely variable.

3. Didymium parietale Martin & Brooks. Plasmodiocarps[12] white or cinereous, laterally compressed, forming an intricate, close meshed network with occasional simple plasmodiocarps or subglobose sporangia interspersed, 0.2-0.4 mm wide, seated on a broadly expanded but colorless and inconspicuous hypothallus. Sporangium wall membranous, fragile, translucent, iridescent, sparsely to densely frosted with discoid or stellate lime crystals. Columella conspicuous, in the form of an elongate, wall-like plate extending longitudinally nearly the length of the plasmodiocarp, at intervals attached to the base by peglike extensions, free above. Capillitium abundant, with numerous anastomoses, the threads slender, brownish and 2 mu in diameter below, becoming hyaline and more slender at the tips, often connected laterally. Spores in mass dark brown, containing vesicular bodies colored like the spores and bearing similar spines

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[12] This description is slightly modified from the original description (8) in accordance with these studies.

and occasionally irregular reticulations. Spores deep violaceous brown by transmitted light, globose, sparsely and irregularly spiny and subreticulate, the spines up to 1 mu in length, the body of the spore 11-13 mu in diameter.

Locally abundant on dead oak leaves. Not reported outside of Kansas. Kansas: TEB 304, Geary County, June 6, 1937 (type); TEB 361, Geary County, September 1937; TEB 365, Geary County, November 7, 1937; TEB 366, Geary County, November 7, 1937; TEB 427, Geary County, June 26, 1938; TEB 453, Geary County, July 16, 1938; TEB 454, Geary County, July 23, 1938; TEB 520, Geary County, August, 1938; TEB 561, Geary County, June 15, 1940; TEB 619, Geary County, August 10, 1940; TEB 620, Riley County, August 17, 1940; TEB 667, collected by Mrs. Brooks in Riley County, September 27, 1940.

Portions of the type collections have been deposited in the collections of the State University of Iowa, Kansas State Agricultural College, New York Botanical Gardens, as well as in the private collections of Professor Meylan in Switzerland, and Eli Davis in London, Ontario.

The most striking feature of the species is the conspicuous, laterally flattened, elongate columella which is usually densely filled with calcareous crystals and extends through the center of the plasmodiocarp, dividing it into two equilateral portions. At the base it is attached at frequent intervals by peglike extensions, and reaches approximately three fourths of the height of the spore mass, but is entirely free from the peridium above.

The peridium is membranous, fragile, and the lime crystals with which it is covered are aggregated into small, but definite scales in which it approaches Lepidoderma, but since several species of Didymium regularly or occasionally bear similar small scales, and since the one

really significant character of Lepidoderma is the presence of large crystalline scales on the peridium, it seems best to refer the species to Didymium, with which its affinities are evident. The spores are also distinctive, deep violaceous brown, bearing thick spines up to 1 mu in length, often sparsely and irregularly spaced and accompanied by a partial, sometimes well developed, irregular reticulation. Associated with the spores are numerous oval or irregular vesicular bodies marked with spines like those of the spores, but only occasionally with reticulations. Were these present in only one of the collections, they would be regarded as evidence of incomplete maturity, but since they occur in all of the gatherings, the inference is that they are characteristic of the species, much as are the vesicles of D. complanatum (Batsch) Rost. distinctive in that species, although in the present species they are not so regular in shape and size as in D. complanatum. The vesicles are usually intimately associated with the capillitium, but are often free.

The hypothallus is an almost invisible film except just under and adjacent to the plasmodiocarp, where it becomes calcareous and merges with the thickened base.

The plasmodium was reported in the original description as probably white. The species has since been observed developing from white plasmodia.

4. Didymium listeri Massee. Plasmodiocarps very thin, effused, perforated, in irregular scattered patches up to 1 cm long, grayish white or slate gray, iridescent in absence of lime. Sporangium wall membranous, tough, colorless, iridescent, sparsely frosted with stellate or irregular lime crystals. Hypothallus scanty or none. Capillitium abundant, consisting of slender, brown to pale brown threads arranged vertically, about

1 mu in diameter, 85-115 mu long, sparingly branched especially near the base and near the top, occasionally connected by horizontal bars. Columella none. Spores brown in mass, violet-gray by transmitted light, spore wall thick and violet-brown, globose, minutely warted, warts arranged to form a subreticulation, 9.5-12 mu in diameter, averaging 10.8 mu.

Occasionally abundant on dead leaves. Previously reported in America only from Iowa (10). Kansas: TEB 589, Riley County, June 13, 1940; TEB 590, Geary County, June 13, 1940; TEB 618, Riley County, September 17, 1940; TEB 724, Riley County, June 10, 1940.

The relationship between D. listeri and D. dubium Rost. is close and obscure. Miss Lister now regards the D. dubium of the 1925 monograph as D. listeri, and D. wilczekii Meylan as D. dubium.[13] According to Nagelstein the distinctions between the species are in the capillitium and the spores. D. listeri usually has thinner plasmodiocarps, with short, parallel, capillitial threads, that are connected somewhat by horizontal bars, and rarely branched. The threads are firmly attached, usually to the upper wall. The spores are grayish or violet in color, and measure about 9-12 mu. D. dubium has an abundant capillitium, much netted and elastic, and free from the wall, so that often it can be removed as a long wormlike mass. The spores are brown, not gray, and measure over 11 mu. Dr. Martin regarded the Kansas material as D. dubium.[8]

5. Didymium rigidum sp. nov. Sporangia forming netlike plasmodiocarps somewhat flattened above, sometimes 2.5 x 6 cm in extent, occasionally interspersed with sessile pulvinate sporangia or short simple plasmodio-

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[13] Personal correspondence from Robert Nagelstein, July 31, 1940 and September 6, 1940.

[8] See footnote 5, p. 36.

carpa, slate gray or cinereous, occasionally yellowish, seated upon a continuous yellow or cinereous hypothallus. Sporangium wall membranous, colorless, iridescent, sparsely to densely sprinkled with minute irregular lime crystals, dehiscing irregularly or lifted as a unit with the capillitium. Columella none. Capillitium abundant, composed of stout, dark purple-brown threads branching and anastomosing to form a rigid, somewhat elastic network, often expanded at the nodes. Spores dark brown in mass, dark violet-brown by transmitted light, globose to ovoid, strongly warted, 11-12.8 mu in diameter, averaging 12 mu.

On dead leaves. Riley County, Kansas: TEB 646, September 22, 1940; TEB 675 (type), September 29, 1940; TEB 691, October 6, 1940; TEB 730, collected by Mrs. Brooks, November 3, 1940.

Of doubtful relationship to D. anellus. Nagelstein considered this as probably D. anellus because of the tendency towards circumscissile dehiscence.[14/] Because of considerable variation in the capillitium of Long Island specimens he considered the much branched, rigid capillitium as a possible variation of D. anellus. Throughout the Kansas specimens the capillitium consists of a rigid, purple-brown network of stout threads, not resembling in any way the delicate, sparingly branched capillitium of D. anellus. The dehiscence is not circumscissile as in D. anellus. The sporangium wall tends to dehisce irregularly, but it is often lifted entire as the capillitium separates from the base. This series of collections appears to represent a new species to which the writer gives the name D. rigidum.

14/ See footnote 10, p. 56.

6. Didymium ochroideum G. Lister. Sporangia scattered, sessile, globose, pulvinate or depressed, or forming pulvinate, depressed, or effused plasmodiocarps sometimes 2.5-5 mm in extent, pale brown, ochraceous, to nearly white, dehiscing irregularly. Sporangium wall membranous, stained with yellow blotches, usually thickly coated with crystalline lime. Capillitium abundant, of slender pale violet-brown threads sparingly branched at acute angles and occasionally united laterally, threads often bearing dark brown beadlike swellings. Spores brown in mass, violet-brown by transmitted light, globose, minutely warted, 6.1-9.4 mu in diameter, averaging 7.8 mu.

Apparently not uncommon in August and September on leaves and weed stems. Collection 680 from Riley County is on the bark of a cottonwood log. Kansas: TEB 600, Riley County, August 19, 1940; TEB 601, Geary County, August 20, 1940; TEB 602, Geary County, August 20, 1940; TEB 603, Saline County, August 22, 1940; TEB 680, Riley County, September 22, 1940.

Closely related on one hand to D. fulvum Sturgis, and on the other hand to D. anellus. From the former D. ochroideum differs in the smaller, paler, smoother spores. The orange base of the sporangia, and the irregular dehiscence distinguishes it from D. anellus.

In minor respects Kansas specimens do not agree with the description of D. ochroideum. The sporangium wall is described as pale orange in color (9). All Kansas specimens studied here have the sporangium wall stained with yellow blotches. Occasionally the yellow blotches are almost indiscernible. As given by Macbride and Martin (10) the color of sporangia is pale brown or ochraceous. Kansas specimens show a variation in color from pale brown and ochraceous to nearly white, although

lime crystals from white sporangia show a yellowish tinge. This variation in color does not seem to be due to fading by sunshine. Usually the sporangium wall is thickly coated with stellate lime crystals. Occasionally the wall is bare of lime, then it is glossy brown. Lime in collection 600 consists of large clusters of yellowish acicular crystals, while in collection 601 the lime is present as stellate and as scalelike crystals. The spores are darker than usual and exhibit a brownish tinge.

7. Didymium squamulosum Fries. Sporangia scattered, stalked, sessile or plasmodiocarpous, globose to hemispheric, umbilicate below, 0.3-0.6 mm in diameter, or forming simple, annulate, or close-meshed plasmodiocarps somewhat flattened, white or cinereous, glossy brown or iridescent in absence of lime, dehiscing irregularly. Sporangium wall a fragile, colorless or pale brown membrane, iridescent, usually densely covered with stellate crystals of lime. Stalk erect, cylindric, white, rugose. columella conspicuous, white, pale, or occasionally orange in color, globose to clavate or being merely the thickened base of the sporangium. Capillitium of brown to pale brown threads stout at the base and becoming finer and paler towards the tips, branching to form a loose net. Spores in mass some shade of brown, violaceous gray to deep violet-brown by transmitted light, globose, minutely spinulose and marked with patches of darker spines, or strongly spinulose, 8-14 mu in diameter.

Occurring commonly on dead leaves and twigs. This appears to be the most abundant and widely distributed, as well as the most variable species of Didymium. Kansas: H. F. Roberts 45 and 45A as D. effusum Link, Riley County, June, 1898; TEB 263, Geary County, January 13, 1936; TEB 305A, Geary County, June 20, 1937; TEB 315 and 317, Geary County, July 4, 1937;

TEB 547, Geary County, May 25, 1940; TEB 594, collected by the writer and Mrs. Brooks in Edwards County, August 4, 1940; TEB 639A, Riley County, September 15, 1940; TEB 654, 655, 700, and 710, collected by the writer and Mrs. Brooks in Riley County, September 22, 1940; TEB 725, collected by the writer and Mrs. Brooks, November 3, 1940; TEB 761, collected by the writer and Mrs. Brooks, Edwards County, August 4, 1940.

Identification of the various phases of D. squamulosum is often difficult because of the wide range of variability present in this species. The sporangia are typically stalked, but sessile and plasmodiocarpous forms are often encountered. The relationship of one collection to this species is doubtful. Lime is usually deposited on the sporangium wall as a loose covering of stellate crystals, but in TEB 263 the lime is present as a shiny, wrinkled crust of closely compacted crystals adhering to the membranous inner wall. In this characteristic the collection approaches D. vaccinum (Dur. & Mont.) Buchet, but differs in paler, smoother spores, the white columella, and the more delicate, colorless capillitium. The sporangia are usually at least shallowly umbilicate below, but are sometimes plane. There is considerable variation in the columella, in prominence, shape, and color. In the stalked phases the columella is usually globose or clavate, and elevated towards the center of the sporangium. In N. F. Roberts 45, and TEB 263 the sporangia are deeply umbilicate below, and the columella is merely the thickened base of the sporangium. In this characteristic these two collections approach somewhat D. intermedium Schroeter, but the columella is not deeply recurved, nor so strongly developed. In plasmodiocarpous phases the columella is scanty or none. Plasmodiocarpous phases apparently develop under adverse condi-

tions as they are in many ways coarser than the typical forms. In normal fruitings the capillitium consists of parallel threads branching somewhat to form a loose network, but in plasmodiocarpous phases the capillitium consists of coarser, darker threads branching and anastomosing to form a firm, close meshed network. The spores of plasmodiocarpous phases are larger, darker, and strongly spinulose.

Sporangia as well as the columella are often confluent. This same characteristic is not with in D. melanospermum (Pers.) MacBr.

TEB 315 and 317 appear to be typical, but instead of the usual white stalks they have grayish stalks. A collection which may be this species is TEB 726. The sporangia are subglobose, plane to slightly umbilicate below, white, stalked. The stalk is pale orange and filled with refuse matter. The outstanding difference is the columella which consists of the stalk protruding into the sporangium as a short, blocky, orange columella.

8. Didymium clavus (Alb. & Schw.) Rabenhorst. Sporangia scattered, stalked, discoid, plane or concave below, often slightly umbilicate above, occasionally confluent, 0.4-1 mm in diameter, white or grayish in color, dehiscing irregularly. Sporangium wall membranous, fragile above, below thicker and more persistent, colorless, frosted with stellate crystals of lime above, naked below. Stalk erect, 0.2-0.7 mm long, black, furrowed, seated on a scanty hypothallus. Capillitium abundant, consisting of parallel brown threads, simple and connected by numerous horizontal bars or branching sparingly to form a loose net, small brown beadlike swellings present. Columella rarely small and black, but usually represented only by the thickened base of the sporangium, then dark brown to nearly white

in color. Spores light brown in mass, gray or grayish brown by transmitted light, globose, warted and marked with patches of darker warts or nearly smooth, 6.7-7.8 mu in diameter averaging 7 mu.

This species appeared abundantly on dead leaves and twigs throughout the season of 1940. Kansas: TEB 563, Geary County, June 13, 1940; TEB 595, collected on Russian thistle in Edwards County by the writer and Mrs. Brooks, August 4, 1940; TEB 694, Riley County, August 25, 1940; TEB 721, collected by the writer and Mrs. Brooks, September 25, 1940; TEB 732, Riley County, September, 1940.

Easily recognized by the peculiar, disc shaped sporangia.

9. Didymium eximium Peck. Sporangia scattered, stalked depressed-globose, umbilicate below, 0.3-0.6 mm in diameter, pale yellow in color, dehiscing irregularly. Sporangium wall membranous, thick, tough, buff or yellow, thickly frosted with crystals of stellate lime. Stalk about 1 mm in length, slightly tapering upwards, erect, pale brown, darker below, nearly smooth, corneous, mounted on a scanty membranous hypothallus. Capillitium not abundant, of branched, colorless threads forming a loose net out toward the sporangium wall. Columella prominent, discoid, yellow, rough or spiny. Spores brown in mass, by transmitted light grayish brown, globose, minutely warted, 9-11 mu in diameter.

This species appeared on leaves in great abundance locally in Geary County in June and August, 1940, and was also found in Riley County in September, 1940. Kansas: TEB 617, collected by the writer and J. Hudspeth in Geary County, August 16, 1940; TEB 639, Riley County, September 15, 1940; TEB 673, collected by the writer and J. M. Koepper in Riley County, September 29, 1940.

Both D. eximium and D. xanthopus (Ditmar) Fr. were considered by Lister to be varieties of D. nigripes (Link) Fr. They appear quite distinct and it seems best to consider each as a separate species. D. eximium is easily distinguished from D. xanthopus by the tough sporangium wall, and the prominent, discoidal, rough columella.

10. Didymium xanthopus (Ditmar) Fr. Sporangia scattered, stalked, globose, 0.3-0.5 mm in diameter, white, dehiscing irregularly. Sporangium wall a thin, fragile, iridescent membrane frosted with stellate calcareous crystals. Stalk slender, tapering upwards, brown, 0.4-1 mm in length, longitudinally striate, containing no refuse matter, mounted on a scanty hypothallus. Capillitium consisting of delicate, colorless threads branching to form a loose net. Columella globose, pallid or white, attaining about the center of the sporangium. Spores brown in mass, violaceous gray by transmitted light, globose, minutely warted 8-10 mu in diameter, averaging 8.3 mu.

On decaying leaves and twigs. Kansas: TEB 453, Geary County, July 24, 1938; TEB 690, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940. These seem to be the only collections which can be regarded as typical D. xanthopus. Although other writers find the species common it does not appear to be so here.

Superficially TEB 423 from Geary County resembles the previously described specimens, but differs in many details. At first glance the columella appears to be subglobose or discoid, but in reality it is strongly recurved somewhat as in D. intermedium. The capillitium is less abundant, consisting of darker threads scarcely branching, and connected by numerous horizontal bars. The spores are larger, darker, and more strongly marked.

Sporangia scattered, stalked, subglobose, 0.2-0.5 mm in diameter, white. Sporangium wall a tough, colorless, iridescent membrane covered with stellate crystals of lime, dehiscing irregularly. Stalk slender, tapering upwards, brown 0.5-0.8 mm in length, corneous, containing no refuse matter, on a scanty but more or less continuous hypothallus. Capillitium scanty, consisting of purple-brown threads vertically arranged, seldom branching, abundantly connected laterally, colorless at tips, dark brown beadlike swellings present, in dehiscence remaining attached to columella. Columella discoid, strongly recurved so as to appear subglobose or somewhat discoid, white. Spores dark brown in mass, violaceous brown by transmitted light, globose, minutely warted and marked with patches of darker warts, 9.5-11.1 mu in diameter, averaging 10.3 mu.

11. Didymium nigripes (Link) Fr. Sporangia scattered, stalked, globose, umbilicate beneath, 0.4-0.5 mm in diameter, gray. Sporangium wall membranous, stained with brown blotches, thickly frosted with stellate crystals of lime, breaking irregularly. Stalk dark brown, corneous, upright, hypothallus scanty. Columella small, dark brown, conic or globose. Capillitium of slender brown threads branching at acute angles to form a loose net. Spores in mass brown, grayish brown by transmitted light, globose, nearly smooth, 7.2-8.3 mu in diameter, averaging 8 mu.

A single collection on decaying leaves. TEB 628, Geary County, Kansas, August 18, 1940.

12. Didymium melanospermum (Pers.) Macbride. Sporangia scattered, stalked or sessile, somewhat hemispheric, umbilicate below, 0.3-0.6 mm in diameter, often confluent, white or gray, glossy brown in absence of lime, dehiscing irregularly. Sporangium wall a thin, iridescent membrane

mottled with purple-brown, more or less richly frosted with large calcareous crystals. Stalk 0.3-0.5 mm in length or shorter, stout, tapering, nearly black in color, containing refuse matter, mounted on a scanty hypothallus. Columella conspicuous, brown to nearly black. Capillitium abundant, consisting of colorless to pale brown parallel threads seldom branching, in dehiscence remaining attached to the sporangium wall. Spores brown in mass, violet-brown by transmitted light, spinulose, 9.8-13 mu in diameter, averaging 10.8 mu.

Common on decaying leaves during the summer and fall. Kansas: TEB 627, Riley County, September 6, 1940; TEB 689, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940; TEB 721, collected by the writer and Mrs. Brooks in Riley County, August 25, 1940; TEB 726, collected by the writer and Mrs. Brooks in Riley County, November 3, 1940; TEB 738, Riley County, September 29, 1940.

12a. Didymium melanospermum biocolor G. Lister. Columella and stalk pale from inclosed deposits of lime granules.

On decaying leaves. Kansas: TEB 623A, Riley County, August 17, 1940; TEB 721B, collected by the writer and Mrs. Brooks in Riley County, August 25, 1940; TEB 726A collected by the writer and Mrs. Brooks in Riley County, November 3, 1940. The var. biocolor has been reported from England, Java, Japan, and Bermuda (9).

13. Didymium minus Morgan. Sporangia scattered, stalked, somewhat hemispheric, umbilicate below, 0.3-0.5 mm in diameter, white. Sporangium wall a thin membrane mottled with purple-brown, densely frosted with stellate crystals of lime, dehiscing irregularly. Stalk upright, 0.5 mm or less in length, tapering upwards, nearly black in color, containing

refuse matter, mounted on a scanty hypothallus. Columella conspicuous, brown. Capillitium abundant, consisting of pale brown, parallel threads, seldom branching, remnants remaining attached to the sporangium wall and especially to the columella. Spores brown in mass, pale violet-brown by transmitted light, globose, minutely spinulose and marked with patches of darker and longer spines, 8-9 mu in diameter, averaging 8.5 mu.

TEB 739, collected on decaying leaves in Riley County, September 29, 1940.

As to whether this is a distinct species from D. melanospermum is doubtful. Lister (9) makes it a variety of D. melanospermum because there are so many intermediate forms uniting the var. minus and the typical form. Macbride and Martin (10) make it a species, distinguishing it from D. melanospermum by the smaller size, the less flattened sporangia, the smoother and usually less limy peridium, the longer stem, and the smaller, paler, less strongly warted spores. D. minus is considered by Hagelstein (6) to be no more than a small phase of D. melanospermum. There does not seem to be sufficient differences among Kansas collections to warrant maintaining D. minus as a separate species. The size of the sporangia of D. melanospermum falls below the range given by other writers, and within the range given by Macbride and Martin for D. minus. In other sections of the country the differences in sporangial size may be clear cut, but there appears to be little difference in Kansas collections.

FAMILY STEMONITACEAE

Sporangia stalked or sessile, globose, oblong, or cylindric, without deposits of lime, or lime present in stalk and columella only. Sporangium wall membranous, evanescent or persistent. Columella typically present and often extending to the apex of the sporangium. Capillitium composed of smooth, hollow threads radiating from the columella or the base of the sporangium. Spores in mass brown to nearly black.

KEY TO GENERA OF STEMONITACEAE

1. Deposits of lime present in the stalk and columella. 10. Diachea.

1. Deposits of lime absent.

2. Capillitium arising over the entire length of the columella; sporangium wall usually evanescent.

3. Capillitium branches anastomosing to form a surface net; sporangia usually closely crowded. . . . . 11. Stemonitis.

3. Capillitium branches free at the tips; sporangia gregarious or scattered, a few species closely crowded . . 12. Comatricha.

2. Capillitium arising from the tip of the columella, poorly developed in some genera; sporangium wall usually more or less persistent.

3. Columella almost or entirely transversing the sporangium.

4. Columella entirely transversing the sporangium forming an expanded disc at the apex from which the capillitium originates. 13. Enerthenema.

4. Columella entirely transversing the sporangium or dividing above into a few simple branches. . . . . 14. Macbrideola.

3. Columella seldom reaching beyond the center of the sporangium.

4. Spores colorless; sporangia very minute . . . 15. Echinostelium.

4. Spores darker.

5. Capillitium forming an intricate network; sporangium usually a persistent iridescent membrane. . . . . 16. Lamproderma.

5. Capillitium of sparingly branched threads bearing persistent fragments of the sporangium wall on their tips. 17. Clastoderma.

Genus 10. Diachea Fries

Stalk, hypothallus, and columella containing deposits of lime. Sporangium wall and capillitium without deposits of lime.

Key to Species of Diachea

1. Sporangia cylindric. . . . . 1. D. leucopodia.

1. Sporangia globose to ovoid.

2. Spores reticulated with lines of fine warts; sporangia short stalked . . . . . 2. D. subsessilis.

2. Spores bearing dark brown, cylindrical protuberances up to 1.5 mu in length . . . . . 3. D. splendens.

2. Spores strongly warted. . . . . 4. D. bulbillosa.

1. Diachea leucopodia (Bull.) Rost. Sporangia gregarious, short stalked, cylindric, occasionally ellipsoid, 0.5-1.2 mm tall, iridescent until dehiscence of sporangium wall, then dark brown. Sporangium wall colorless, membranous, rugose, somewhat persistent, especially below. Stalk white, calcareous, 0.2-0.4 mm in length. Hypothallus white, scanty, or none. Columella white, calcareous, slender, reaching nearly to the apex of the sporangium. Capillitium a lax network of brown threads with pale tips. Spores dark brown in mass, dull violaceous by transmitted light, globose, minutely warted, 9-10 mu in diameter.

Commonly fruiting on strawberry plants, raspberry canes, dead leaves, etc. Kansas: J. B. S. Norton 36, Riley County, August, 1893; A. S. Hitchcock 26, Riley County, June 30, 1897; F. U. G. Agrelius 76, Lyon County, September 14, 1927.

2. Diachea subsessilis Peck. Sporangia gregarious, short stalked or sessile, globose, 0.2-0.5 mm in diameter, iridescent blue or violet. Sporangium wall thin, membranous, colorless, somewhat persistent. Stalk white, stout, calcareous, 0.1-0.3 mm in length. Hypothallus scanty, white, calcareous, or none. Columella white, conic or nearly obsolete. Capillitium a lax network of slender, branching and anastomosing, violaceous brown to nearly colorless threads radiating from the columella. Spores in mass dark brown, violaceous green by transmitted light, globose, reticulated with lines of fine warts, 9.4-11 mu in diameter.

On fallen leaves. Kansas: TEB 303A, Geary County, July, 1937; TEB 326, Geary County, May, 1937; TEB 788, Riley County, 25, 1940.

The peculiar violaceous green color of the spore results from the blending of the violet color of the spore wall with the pale yellow color of spore contents.

3. Diachea splendens Peck. Sporangia gregarious, stalked, rarely sessile on a more or less continuous, white, calcareous hypothallus, globose to subglobose, 0.2-0.5 mm in diameter, blue with violet tints, often brilliantly iridescent. Sporangium wall thin, membranous, colorless, rugose, somewhat persistent. Stalk white, calcareous, stout, tapering upwards or even, 0.3-0.8 mm in length. Hypothallus usually scanty or none. Columella white, cylindrical, obtuse, extending beyond the center of the sporangium. Capillitium branching and anastomosing to form a network of

slender dark brown threads radiating from the columella, colorless as they leave the columella and pale at the tips. Spores nearly black in mass, violet-brown by transmitted light, bearing dark brown cylindrical protuberances up to 1.5 mu in length, also marked with a faint grayish reticulation, and usually with scattered warts, 7.8-9.4 mu in diameter.

Collected in abundance on leaves, sticks, moss, etc. Kansas: TEB 671, collected by the writer, Mrs. Brooks, and J. M. Koepper in Riley County, September 27, 1940; TEB 672, Riley County, September 29, 1940; TEB 709, collected by the writer and Mrs. Brooks, September 22, 1940.

4. Diachea bulbillosa (Berk. & Br.) Lister. Sporangia gregarious, stalked, rarely sessile, globose to ovoid, 0.2-0.4 mm in diameter, brilliantly iridescent. Sporangium wall thin, membranous, colorless, rugose, somewhat persistent, falling away in large fragments. Stalk white, calcareous, shining, broad at the base, narrowing rapidly upwards, 0.4-0.8 mm in length. Hypothallus scanty or none. Columella clavate, reaching nearly to the apex of the sporangium, white. Capillitium branching and anastomosing to form a lax network of slender purple-brown threads radiating from the columella, pale at the tips. Spores nearly black in mass, grayish violet by transmitted light, globose, strongly spinulose, and marked by a faint grayish reticulation, 8.5-11 mu in diameter.

On fallen leaves and wood. Kansas: TEB 642, Riley County, September 15, 1940; TEB 709, Riley County, September 29, 1940.

The spores of D. bulbillosa, like those of D. splendens, are marked with faint, gray, lax reticulations. D. splendens, which was considered a variety of D. bulbillosa has spores bearing blunt cylindrical protuberances whereas the spores of the latter species are strongly spinulose (9).

The two species are easily separated with the unaided eye. Sporangia of D. splendens are a beautiful blue, whereas the sporangia of D. bulbillosa are bluish gray.

Genus 11. Stemonitis Gleditsch

Sporangia closely crowded, stalked, cylindric. Sporangium wall evanescent. Stalk black, setaceous, continuing into the sporangium as a columella continuing almost to the apex. Capillitium arising the entire length of the columella, anastomosing at the surface to form a network of threads parallel to the sporangium wall.

Key to Species of Stemonitis

1. Spores reticulate.
   2. Sporangia 5-8 mm tall, brown. . . . . 1. S. fusca.
   2. Sporangia 1.4-3 mm tall, dark brown to nearly black. 2. S. nigrescens.
1. Spores spinulose, warted, to nearly smooth.
   2. Spores less than 7 mu in diameter.
      3. Sporangia 6-8 mm tall; spores 5.5-7 mu in diameter. 3. S. axifera.
      3. Sporangia 1.5-2.5 mm tall; spores 4.4-5 mu in diameter. 4. S. smithii.
   2. Spores more than 7 mu in diameter.
      3. Sporangia usually 10-19 mm tall, flexuose. . . . 5. S. splendens.
      3. Sporangia less than 10 mm tall, upright.
         4. Surface net with meshes 10-60 mu wide. . . . . 6. S. webberi.
         4. Surface not delicate.

5. Columella often with platelike expansions at the apex.
7. S. flavogenita.

5. Columella without platelike expansions; sporangia usually in small scattered clusters on leaves and herbaceous stems.
8. S. herbatica.

1. Stemonitis fusca Roth. Total height 5-8 mm. Sporangia in tufts, flexuose, stalked, cylindric, some shade of brown in color. Stalks 1.5-2.2 mm in length, black, slender, mounted on a membranous hypothallus red near the base of the stalk, otherwise colorless, shining, somewhat iridescent. Columella slender, dissolving into the capillitium just below the apex of the sporangium. Capillitium of abundant purple-brown threads giving rise to the delicate, spinulose or smooth, brown surface net with meshes 3-40 mu across. Spores violaceous by transmitted light, globose, marked with reticulations of spines which are often connected by ridges, 6-9 mu in diameter.

Common on wood. Found occasionally fruiting on dead attached leaves of yucca. Kansas: F. U. C. Agrelius 8, Douglas County, June 10, 1909; F. U. C. Agrelius 20, Harvey County, August 27, 1907; F. U. C. Agrelius 63, Lyon County, September 13, 1916; TEB 321, Geary County, July 5, 1937; TEB 455, 456, and 457, Geary County, July 24, 1938; TEB 586, Geary County, June 13, 1940. TEB 439 collected by Mrs. Brooks in Edwards County in July 1940; and TEB 778F collected by Mrs. Brooks in Edwards County in August, 1940 are from 1.5 to 4 mm tall, and in TEB 570 the surface net is poorly developed. These collections may represent S. fusca matured under adverse conditions.

2. Stemonitis nigrescens Rex. Total height 1.4-3 mm. Sporangia in somewhat dense clusters up to 1 cm across, stalked, erect, cylindric, dark brown to nearly black. Stalk black, shining, 0.1-0.8 mm in length,

arising from a continuous, reddish brown membranous hypothallus. Columella slender, black, tapering upwards, reaching to the apex of the sporangium. Capillitium composed of dark brown threads springing from all parts of the columella forming a loose network, ultimately anastomosing into a delicate surface net with many free ends; meshes irregular, varying from 3-20 mu across, often imperfectly developed in the upper part of the sporangium. Spores dark brown in mass, violaceous brown by transmitted light, globose, reticulated with rows of spines, 8-9.5 mu in diameter.

Not uncommon on wood. Kansas: TEB 236, Geary County, June 13, 1937; TEB 330, Geary County, July 18, 1937.

Distinguished from S. fusca by small darker sporangia, comparatively shorter stalks, and somewhat larger, violaceous brown spores.

3. Stemonitis axifera (Bull.) Macbr. Total height 6-8 mm. Sporangia in small clusters, cylindric, stalked, reddish brown. Stalks 2 mm long, black, slender, even, rising from a continuous hypothallus. Columella slender, black, tapering upwards, dissolving into the capillitium well below the apex of the sporangium. Capillitium of brown threads forming a network of medium density; surface net with many free short threads, brown, with meshes 7-40 mu wide. Spores almost colorless by transmitted light, globose to slightly oval, spinulose to almost smooth, 5.5-7 mu in diameter.

Not uncommon on wood. Kansas: F. U. C. Agrelius 1, Douglas County, November 17, 1906; F. U. C. Agrelius 75, Harvey County; TEB 9A, Geary County, November 8, 1936; TEB 451, Geary County, July 24, 1938.

4. Stemonitis smithii Macbr. Total height 1.5-2.5 mm. Sporangia fasciculate in clusters usually less than 6 mm across, erect, stalked,

cylindric, brown with a reddish cast. Stalks 0.4-1 mm in length, black, slender, even. Hypothallus continues, membranous, brown. Columella slender, black, dissolving into the capillitium just below the apex of the sporangium. Capillitium a moderately dense network of brown threads giving rise to a delicate, light brown surface net. Spores pale by transmitted light, globose, with wall thinner on one side, nearly smooth, 4.4-5 mu in diameter.

TEB 339, collected on wood in Geary County, Kansas, August 29, 1937.

S. smithii is closely affiliated with S. axifera and perhaps merely a phase of the latter. Differing from the S. axifera in the smaller size and smaller spores.

5. Stemonitis splendens Rost. Total height 10-19 mm. Sporangia closely fasciculate, usually in large clusters, flexuose, stalked, sometimes almost sessile, narrowly cylindric, brown, often purplish brown after dispersion of spores. Stalk 2.5-3.5 mm in length, black, shining, slender. Hypothallus continuous, thin, membranous, silvery, or where thicker reddish brown in color. Columella ending somewhat abruptly at or just below the apex of the sporangium. Capillitium composed of brown to purplish brown threads arising at intervals along the columella, or branching and anastomosing to form a loose network, often with numerous membranous expansions; surface net smooth, light brown to purplish brown, with meshes 7-65 mu across. Spores pale violet-brown by transmitted light, globose, wall often thinner on one side, evenly warted, 7-9 mu in diameter.

Common on dead wood. Kansas: F. U. G. Agrelius 5, Douglas County, October 5, 1910; F. U. G. Agrelius 14, Douglas County, September 12, 1906;

TEB 9, Geary County, May, 1936; TEB 55, Riley County, June 27, 1937; TEB 461, Geary County, July 10, 1938.

TEB 778A, 778C, and 790, collected by Mrs. Brooks in Edwards County, Kansas during August, 1940, appear to be this species developed under very adverse conditions. The sporangia are sessile, or nearly so, on a continuous hypothallus, 3-4 mm tall, and upright, somewhat weak. The surface net is usually as in the typical form, but is often poorly developed.

Lister considered forms of S. splendens having the meshes of the surface net 80-100 mu across as the var. webberi (9). Macbride and Martin described S. webberi Rex as usually 8-10 mm tall, but occasionally 6-15 mm tall (10).

Several collections agreeing with S. splendens in all other respects have meshes of the surface net 30-100 mu across.

6. Stemonitis webberi Rex. Total height 1.5-3.5 mm. Sporangia loosely and irregularly clustered, often in large colonies, stalked, erect, cylindric, 1-3 mm long, 0.3-0.4 mm in diameter, purple-brown in color. Stalk dark red to nearly black, setaceous, 0.5-1.0 mm in length. Hypothallus more or less continuous, thin, membranous, colorless, somewhat iridescent, reddish near the base of the stalk. Columella tapering upwards and dissolving into the capillitium at the apex of the sporangium or often ending abruptly below the apex, sometimes ending with a membranous expansion. Capillitium lax, composed of purple-brown threads springing from all parts of the columella, branching freely, anastomosing at the surface forming an irregular net with few peridial processes, with meshes varying from 10-60 mu across. Spores dark brown in mass, brown by transmitted light, globose to slightly oval, warted, 9-11 mu in diameter.

On decaying wood. Kansas: TEB 510, Geary County, June 1938; TEB 720, Riley County, August 25, 1940.

7. Stemonitis flavogenita Jahn. Total height 7-9 mm. Sporangia closely fasciculate in small clusters, stalked, cylindric, light brown in color. Stalk slender, black, 2 mm in length, arising from continuous brown hypothallus. Columella slender, black, tapering upwards reaching the apex of the sporangium, there often expanded into a membranous plate. Capillitium of brown threads springing from all parts of the columella forming a loose network with many membranous expansions, anastomosing to form an even surface net of meshes 4-22 mu across. Spores pale violaceous brown by transmitted light, globose, minutely and faintly warted, 7-9.5 mu in diameter.

On wood. Kansas: TEB 778E, collected by Mrs. Brooks in Edwards County in August, 1940.

8. Stemonitis herbatica Peck. Total height 1.4-5 mm. Sporangia fasciculate in small clusters, erect, stalked, sometimes almost sessile, cylindric, brown, sometimes interspersed with small, globose or oblong sporangia. Stalk 0.4-1 mm in length, black, shining, slender, nearly even, arising from a continuous membranous hypothallus almost imperceptible except near the base of the stalk where the hypothallus is reddish in color. Columella black, slender, narrowing upwards, dissolving into the capillitium near the apex of the sporangium. Capillitium a loose or somewhat dense network of brown threads, often with many membranous expansions, at the surface giving rise to delicate, spinulose or smooth network of light brown threads with meshes 8-22 mu across. Spores

light violaceous brown by transmitted light, globose, minutely and closely warted, 8.3-9 mu in diameter.

Not uncommon on dead leaves, weed stems, and occasionally on wood. Kansas: TEB 288, Geary County, June 13, 1937; TEB 556, Riley County, June 5, 1940; TEB 607, Fort Riley Reservation, August 21, 1940; TEB 623, Riley County, August 17, 1940; TEB 748, Geary County, August 15, 1940.

Sometimes occurring in large dense colonies on sweet potato seedlings in cold frames.

Genus 12. Comatricha Preuss

Similar to Stemonitis but usually lacking the definite surface net present in Stemonitis, and not usually being closely crowded. Some species approach the genus Lamproderma but differ in the absence of the persistent sporangium wall.

Key to Species of Comatricha

1. Sporangia closely crowded.

2. Sporangia 7-14 mm long, weak; spores spinulose, the spines forming a close reticulation. . . . . 1. C. longa.

2. Sporangia 1.6-2 mm tall, erect; spores spinulose to nearly smooth. 2. C. irregularis.

1. Sporangia gregarious to scattered but not closely clustered.

2. Capillitium simple, with few or no anastomoses; sporangia minute.

3. Capillitium a small tuft of nearly simple threads with clavate tips. 3. C. fimbriata.

3. Capillitium of a few rigid, branching but scarcely anastomosing threads; stalk a smooth-walled tube. . . . . 4. C. cornea.

2. Capillitium intricate.

3. Capillitium arising from the tip of the short columella.

4. Spores purplish brown by transmitted light. . . . 5. C. elegans.

4. Spores reddish violet by transmitted light. 5a. C. elegans pallens.

3. Capillitium arising along the entire length of the columella.

4. Spores usually over 8 mu in diameter.

5. Spores pale lilaceous brown by transmitted light.
6. C. rufescens.

5. Spores purple-brown by transmitted light.

6. Primary branches of capillitium stout and nearly straight.

7. Columella almost reaching the apex of the sporangium.
7. C. laxa.

7. Capillitium scanty, rigid; columella usually branching well below the apex into 2 or 3 stout branches. 7a. C. laxa rigida.

6. Capillitium dense, composed of slender flexuose threads.
8. C. nigra.

4. Spores usually under 8 mu in diameter.

5. Spores marked with 3-7 large, prominent warts per hemisphere.
9. C. typhoides.

5. Spores more or less evenly warted or spinulose.

6. Sporangium wall persistent in the lower fourth to which capillitial threads are attached. . . . . 10. C. rubens.

6. Sporangium wall not persistent.

7. Capillitium dark purple-brown; spores pale brownish gray; on wood. . . . . 11. C. subcaespitosa.

7. Capillitium paler.

8. Sporangia globose to cylindric.

9. Capillitium a network of slender, brown threads usually forming an imperfect surface net . . . 12. C. pulchella.

9. Capillitium a network of more rigid, purple-brown threads not usually forming a surface net. . . . . 12a. C. pulchella fusca.

8. Sporangia narrowly cylindric, reddish. 13. C. tenerrima.

1. Comatricha longa Peck. Sporangia closely crowded, stalked, drooping, 7-14 mm long, cylindric, black. Sporangium wall evanescent. Stalk slender, black, shiny, 1-2 mm in length, rising from a more or less continuous, brownish, membranous hypothallus. Columella black, gradually tapering upwards almost to the apex of the sporangium, below often dividing into two equal branches. Capillitium an open network of sparingly branching and anastomosing dusky brown threads with many outwardly pointed free ends. Spores nearly black in mass, brownish purple by transmitted light, globose, spinulose, the spines forming a close reticulation, 9.4-11 mu in diameter.

H. P. Roberts 17A, collected on the bark of an elm log near Manhattan, Riley County, Kansas, in July, 1897.

2. Comatricha irregularis Rex. Total height 1.5-2 mm. Sporangia closely clustered, stalked, erect, cylindric, 0.3 mm in diameter, dark purple-brown in color. Sporangium wall evanescent. Stalk slender, 0.5-0.8 mm in length, shining, nearly black above, reddish brown below, rising from a somewhat continuous reddish brown hypothallus. Columella black, slender, gradually tapering upwards, zigzagging near the tip, reaching, or almost reaching, the apex of the sporangium. Capillitium a lax network of purple-brown, branching and anastomosing threads forming an irregular net at the surface of the sporangium. Spores dark purple-brown in

mass, purple-brown, often paler on one side, globose, spinulose to nearly smooth, 8.3-9.5 mu in diameter.

On wood. Kansas: TEB 13, Geary County, March 21, 1936.

The sporangia of this collection are somewhat shorter than described by Lister (9) and Macbride and Martin (10). The latter described the spores as black in mass, brown by transmitted light, echinulate.

3. Comatricha fimbriata G. Lister & Cran. Nagelstein reported that this species was present on the portion of collection TEB 374 along with Macbridesla scintillans Gilbert.[15/]

TEB 374 developed in February 1938 on bark collected in Geary County, Kansas, soaked in water for about 24 hours, then kept in a moist chamber.

4. Comatricha cornea G. Lister & Cran. Sporangia scattered or solitary, stalked, globose, 0.5-0.15 mm in diameter, brown in color. Sporangium wall persistent as an irregular brown membranous collar at the base of the sporangium. Stalk 0.1-0.5 mm in length, slender, tapering upwards from a scanty membranous hypothallus, corneous, yellowish brown at the base, becoming dark reddish brown above. Columella cylindric, reaching half the height of the sporangium, dividing at the tip into several branches giving rise to the capillitium and often giving rise to a few scattered capillitial threads over the entire length. Capillitium scanty, of brown or pale threads branching sparingly. Spores brown in mass, lilaceous gray to lilaceous by transmitted light, globose, sparingly and irregularly warted, 7.8-10.6 mu in diameter.

[15/] Personal correspondence from Robert Nagelstein, January 24, 1938.

Apparently common on the bark of living deciduous trees. Although natural fruitings were not collected, the species fruited abundantly on the bark of living trees moistened and kept in a moist chamber. Geary County, Kansas: TEB 374, December, 1937; TEB 543, January, 1938; TEB 549, May 27, 1940; 549A, May 29, 1940; TEB 553, June 4, 1940; TEB 553A, June 6, 1940; TEB 557, June 5, 1940; TEB 780, January 12, 1941; TEB 585, January 23, 1941. Previously reported from Scotland, Germany, and Switzerland (10).

The stalk when treated with lacto-phenol is shown to be a smooth-walled tube. On the basis of this unusual characteristic Nagelstein confirmed the writer's belief that these collections represent Comatricha cornea.[16/] European specimens were described as 0.12-0.32 mm in diameter with stalks 0.17 to 0.2 mm high, and with spores gray in color (9). The young sporangia are white, becoming amber, then brown.

5. Comatricha elegans Lister. Sporangia gregarious, stalked, globose, 0.3-0.4 mm in diameter, purple-brown in color. Sporangium wall evanescent. Stalk slender, subulate, black, 0.5-0.7 mm in length, rising from a scanty hypothallus. Columella soon dividing into stout branches which repeatedly subdivide giving rise to the dense, branching and anastomosing purple-brown threads which form the capillitium. Spores purple-brown in mass, purplish brown by transmitted light, globose, minutely and closely spinulose, 9.4-11 mu in diameter.

On decaying wood. Kansas: TEB 585, Geary County, June 13, 1940.

[16/] Personal correspondence from Robert Nagelstein, June 22, 1940.

5a. Comatricha elegans pallens G. Lister. Sporangia subglobose, 0.2-0.4 mm in diameter, reddish lilac in color. Stalk slender, black, subulate, 2-2.5 mm in length, enclosed in a colorless membrane. Hypothallus none. Spores reddish violet in mass, pale reddish violet by transmitted light, minutely spinulose, 8.3-9.4 mu in diameter.

On twigs. Kansas: TEB 615, Geary County, August 21, 1940. Previously reported from England and New York.

6. Comatricha rufescens sp. nov. Total height 0.3-0.6 mm. Sporangia gregarious, stalked, globose to oval, 0.2-0.4 mm in diameter, reddish in color. Sporangium wall evanescent. Stalk one third to one half the total height of the sporangium, stout, dark red, deeply furrowed, arising from a scanty hypothallus. Columella dark red, tapering upwards, reaching almost to the apex of the sporangium. Capillitium arising from all parts of the columella, composed of reddish flexuose threads branching and anastomosing to form a dense network with many free tips. Spores brownish red in mass, lilaceous brown by transmitted light, globose, minutely spinulose, 8.3-9 mu in diameter.

On the bark of a living cottonwood tree. Kansas: TEB 458, Geary County, July 24, 1938 (type collection); TEB 469, Geary County, July 17, 1938.

These collections seem to be closely related to C. tenerrima G. Lister, but differing in the comparatively shorter, furrowed, dark red stalk, and the somewhat larger spores.

7. Comatricha laxa Rost. Total height 0.3-1.5 mm. Sporangia scattered or gregarious in small clusters, stalked, globose, oval, to short cylindric. 0.3-0.4 mm in diameter, purple-brown in color. Sporangium wall membranous,

evanescent, occasionally somewhat persistent. Stalk one third to two thirds the total height of sporangium, black, reddish brown at the base, setaceous, terete, narrowing upwards. Hypothallus scanty, reddish brown. Columella black, tapering upwards, dissolving into the capillitium just below the apex of the sporangium, occasionally dividing into several branches near the tip. Capillitium lax or dense, purplish brown, with the primary branches straight or somewhat flexuose, arising at nearly right angles along the entire length of the columella, branching and anastomosing, often forming an imperfect surface net below; free ends abundant above. Spores in mass purple-brown, purplish brown by transmitted light, globose, spore wall thinner and spore paler on one side, minutely warted, 8-11 mu in diameter.

Not uncommon on decaying wood and on the bark of living trees. Kansas: TEB 280, Riley County, June 15, 1937; TEB 344, Geary County, October 6, 1937; TEB 345, Geary County, September 6, 1937; TEB 347, Geary County, October 6, 1937; TEB 355, Geary County, October 7, 1937.

Differing from C. nigra (Pers.) Schroeter in the comparatively shorter stalk and the usually more open capillitium.

7a. Comatricha laxa rigida Brandza. Capillitium scanty, rigid. Columella usually dividing well below the apex of the sporangium into two or three stout branches.

TEB 347A, Geary County, Kansas, October 6, 1937.

8. Comatricha nigra (Pers.) Schroeter. Sporangia gregarious to scattered, stalked, subglobose to short cylindric, 0.2-0.3 mm in diameter, purple-brown. Sporangium wall evanescent. Stalk black, 0.3-0.6 mm in length, slender, tapering slightly from a scanty colorless hypothallus.

Columella black, reaching almost to the apex of the sporangium, above often dividing into two or three stout branches. Capillitium purple-brown, arising along the entire columella, branching and anastomosing to form a somewhat dense network ending at the surface with free ends. Spores purple-brown in mass, purplish brown by transmitted light, globose, the wall thinner on one side, minutely warted, 9-11 mu in diameter.

Not uncommon on wood. Kansas: TEB 236, Geary County, June 5, 1936; TEB 564, Geary County, June 13, 1940.

Distinguished from C. laxa by the long slender stalk.

9. Comatricha typhoides (Bull.) Rost. Total height 1-3.5 mm. Sporangia gregarious to scattered, stalked, erect, cylindric, 0.2-0.4 mm in diameter, 0.6-1.7 mm in length, silvery gray until dehiscence of the soon evanescent sporangium wall, then brown to purplish brown in color. Stalk reddish brown to nearly black, usually slender, enclosed in a silvery, membranous sheath which is an extension of the sporangium wall, one third to two thirds the height, rising from a well-developed reddish brown hypothallus. Columella dark, slender, tapering upwards, dissolving into the capillitium below the tip of the sporangium. Capillitium springing from all parts of the columella, the primary branches rather stout, giving rise to the dense network of branching and anastomosing, flexuose, brown threads which form a surface net below. Spores in mass brown, pale by transmitted light, globose, marked with 3-7 prominent dark warts per hemisphere, otherwise nearly smooth, 6-8.3 mu in diameter.

Common on decaying wood and grass. Kansas: H. F. Roberts 20, Riley County, 1898; F. U. G. Agrelius 6, Douglas County, October 5, 1910; F. U. G. Agrelius 6, Lyon County, September 14, 1916; F. U. G. Agrelius 11 and 12, Douglas County, June 19, 1910; F. U. G. Agrelius 69, Harvey County,

August 27, 1907; TEB 232, Geary County, July 14, 1936; TEB 338, Geary County, August 29, 1937; TEB 339A, Geary County, September 27, 1937; TEB 447, Geary County, July 24, 1938; TEB 541, Geary County, July 3, 1938.

Hagelstein identified TEB 541 as C. typhoides similis Lister which was described as having an evanescent sporangium wall and lacking the silvery membranous sheath.[17] The sheath is almost indiscernible when closely attached to the stalk, but almost always can be seen at least as a silver, longitudinal streak. The var. similis appears to have been described from material in which the silvery sheath was present, but hardly discernible, and therefore the variety would be useless.

10. Comatricha rubens Lister. Sporangia gregarious to scattered, stalked, subglobose to ovoid, 0.2-0.4 mm in diameter, brown in color. Sporangium wall evanescent above, membranous, brown, somewhat iridescent, persistent in the lower quarter of the sporangium. Stalk black, setaceous, 0.2-0.5 mm in length, mounted on a scanty, reddish-brown, membranous hypothallus. Columella black, cylindric, reaching about two thirds the height of the sporangium and branching at the apex. Capillitium composed of purple-brown threads springing from all parts of the columella, usually expanded at the base, branching and anastomosing at wide angles, below attached to the persistent base of the sporangium wall. Spores brown in mass, lilaceous by transmitted light, globose, minutely roughened, about 7.2 mu in diameter.

On decaying leaves. Kansas: TEB 311B, Geary County, June 20, 1937.

TEB 311B is typical except for the brown spore mass and smoother spores. Sporangia of C. rubens are typically pinkish brown (9).

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[17] See footnote 6, p. 41.

11. Comatricha suboaespitosa Peck. Total height 1.5-2 mm. Sporangia gregarious, stalked, cylindric, 0.2-0.3 mm in diameter, 1-1.5 mm high, brown in color. Stalk slender, black, shining 0.3-0.5 mm in length. Hypothallus scanty, dark. Columella black, tapering upwards, almost reaching the apex of the sporangium. Capillitium a network of flexuose, dark purple-brown threads forming a definite surface net. Spores brown in mass, pale brownish gray by transmitted light, globose, minutely warted, 6.7-7.8 mu in diameter.

On decaying wood. Kansas: TEB 539, Geary County, June, 1938.

Closely allied to C. typhoides but differing in the minutely but evenly warted and slightly darker spores. C. suboaespitosa differs from C. pulchella gracilis Lister in the darker capillitium, the more even surface net, and the occurrence of the fruitings on wood.

12. Comatricha pulchella (Bab.) Rost. Total height 0.4-1.2 mm. Sporangia gregarious in small clusters, or scattered, stalked, globose, ovate, to cylindric, 0.2-0.4 mm in diameter, 0.2-1 mm high, reddish brown in color. Stalk black, shining, nearly even, 0.1-0.4 mm in length, rising from a circular, reddish hypothallus. Columella black, shining, slender, extending nearly to the apex of the sporangium. Capillitium a network of flexuose, branching and anastomosing brown threads, somewhat stout at the base, slender and with free ends at the surface. Spores reddish brown in mass, pale lilaceous brown by transmitted light, globose, minutely spinulose, 7-8.3 mu in diameter.

On fallen leaves. Kansas: TEB 329, Geary County, July 18, 1937; TEB 542, Geary County, July 10, 1938; TEB 754, Geary County, August 15, 1940.

12a. Comatricha pulchella fusca Lister. Sporangia brown in color. Capillitium composed of more rigid, purple-brown threads with many free ends. Spores pale grayish brown by transmitted light.

On fallen leaves. Kansas: TEB 568, Riley County, June 13, 1940; TEB 745A, Geary County, August 16, 1940.

13. Comatricha tenerrima Lister. Sporangia narrowly cylindric, reddish brown in color. Capillitial threads united below to form an uneven surface net. Spores pale violet-gray by transmitted light, minutely spinulose, 7-8.3 mu in diameter.

TEB 749, collected on fallen leaves and dead grass stems in Geary County, Kansas, August 15, 1940.

Genus 13. Enerthenema Rowman

Sporangia gregarious, stalked, globose. Sporangium wall evanescent. Columella entirely traversing the sporangium forming an expanded disc at the apex from which the sparingly branched capillitium originates.

1. Enerthenema papillatum Rost. Sporangia gregarious, stalked, globose, 0.3-0.6 mm in diameter, brown, tipped with the small shining dark brown expansion of the columella. Sporangium wall evanescent except for a small brown collar at the base of the sporangium. Stalk stout, tapering upwards, equaling diameter of sporangium, black, shiny, slightly furrowed. Columella unbranched, somewhat cylindric, slender, traversing the sporangium and expanding into a dark brown cuplike disc. Capillitium abundant, radiating from beneath the cuplike expansion of the columella, consisting of long, simple or sparingly branched, brown, flexuose threads. Spores brown, globose, minutely warted, 10-12 mu in diameter.

TEB 560, collected on decaying wood, Geary County, Kansas, June 13, 1940.

Genus 14. Macbrideola Gilbert

Sporangia scattered, stalked, globose to subglobose. Sporangium wall membranous, colorless, persistent. Stalk setaceous, continuing into the sporangium as a columella entirely traversing the sporangium, or dividing above into a few simple branches.

1. Macbrideola scintillans Gilbert. Sporangia solitary, stalked, subglobose to slightly ovoid, 0.05-0.1 mm in diameter, shining. Sporangum wall membranous, fragile, colorless, shiny with depressed spots, falling away leaving a small brown collar at the base. Stalk slender, tapering upwards from a small circular hypothallus, terete, brown, corneous. Columella a continuation of the stalk, concolorous, corneous, tapering, extending unbranched to the top of sporangium, or extending well into the sporangium, then branching dichotomously into a few simple threads. Spore mass brown, separated from sporangium wall leaving a free space. Spores violaceous by transmitted light, globose, minutely and irregularly spinulose, 8.5-11 mu in diameter.

Observed several times fruiting sparingly on elm bark cultured in moist chambers. Kansas: TEB 374, December, 1937; TEB 374A, Geary County. February, 1937; TEB 394, Geary County, February 17, 1938.

Macbrideola differs from Lamproderma in the structure of the columella and capillitium. In Lamproderma the columella usually reaches to half or more the height of the sporangia and the capillitium consisting of branched anastomosing threads radiating chiefly from the upper part of columella.

The columella of Macbrideola extends almost the height of the sporangium, and may remain unbranched or branch sparingly toward the top into a few short simple threads.

Genus 15. Echinostelium de Bary

Sporangia gregarious or scattered, stalked, globose, minute, white or pale. Sporangium wall persistent as a small collar at the base of the sporangium. Columella very short, giving rise to the scanty colorless capillitium. Spores colorless by transmitted light.

1. Echinostelium minutum de Bary. Sporangia scattered, stalked, globose, 40-60 mu in diameter, nearly white in color. Stalk upright, 165-220 mu in lengthor, slender, 9-11 mu in diameter at the base tapering to about 2 mu in diameter at the top, colorless but filled with nearly colorless granular matter except near the top, seated on a small circular hypothallus. Sporangium wall persistent as a small circular collar at the base of the sporangium. Columella colorless, slender, up to 25 mu long. Capillitium scanty, consisting of few slender, colorless or pale zigzagging threads branching and anastomosing with free hooklike branches. Spores in mass nearly white, colorless by transmitted light, faintly and minutely warted, 6-7 mu in diameter.

TEB 376 developed in a moist chamber in January, 1938 on pine bark collected in Geary County. Probably common but usually overlooked because of its minute size.

Echinostelium minutum is the smallest Myxomycete described. It has been collected rarely but in widely separated localities in the United States and Europe.

Genus 16. Lamproderma Rostafinski

Sporangia gregarious or scattered, stalked, globose to subglobose, usually brilliantly iridescent. Sporangium wall membranous, more or less persistent. Stalk black, setaceous, continuing into the sporangium as a cylindric or clavate columella which scarcely reaches the center. Capillitium abundant, originating from the tip of the columella.

1. Lamproderma scintillans (Berk. & Br.) Morgan. Sporangia gregarious, stalked, erect, globose or subglobose, often somewhat umbilicate below, 0.2-0.4 mm in diameter, blue, violet, red, gold, bronze, or silvery, usually brilliantly iridescent. Sporangium wall membranous, thin, colorless or pale, often with a brown, more persistent base, falling away in large fragments. Stalk 0.1-1.7 mm in length, black, slender, setaceous, even or slightly tapering upwards from a small circular reddish brown hypothallus. Columella cylindric, not reaching the center of the sporangium, black. Capillitium almost colorless at the base, composed of straight, rigid, purple-brown threads radiating from the tip of the columella, branching dichotomously and anastomosing near the extremities, often pale at the tips. Spores brown by transmitted light, globose, warted, 7.2-11 mu in diameter.

Very common on dead leaves. Kansas: TEB 303, Geary County, June 20, 1937; TEB 311, Geary County, June 20, 1937; TEB 311A, Geary County, July 4, 1937; TEB 327, Geary County, July 18, 1937; TEB 565, Geary County, June 13, 1940; TEB 572 and 575 collected by Mrs. Brooks in Edwards County, June, 1940; TEB 587, Riley County, June 13, 1940; TEB 606, Fort Riley Reservation, August 21, 1940; TEB 610, Saline County, August 22, 1940; TEB 711, collected by the writer and Mrs. Brooks in Riley County, September

22, 1940; TEB 736, Riley County, September 29, 1940; TEB 748A, Geary County, August 15, 1940; TEB 762A, Riley County, June 15, 1940; TEB 783, collected by the writer and Mrs. Brooks in Edwards County, August 4, 1940.

Genus 17. Clastoderma Blytt

Sporangia gregarious or scattered, stalked, subglobose. Sporangium wall persistent as fragments adhering to the tips of the capillitial threads.

1. Clastoderma debaryanum Blytt. Sporangia scattered, stalked, subglobose, 0.1-0.2 mm in diameter, copper-red in color. Sporangium wall evanescent except for the small, irregular, shiny patches adhering to the tips of the capillitial threads and a small collar at the base of the sporangium. Stipe long, tapering from a scanty hypothallus, often unequal, somewhat furrowed, dark brown below, paler above. Columella very short, dividing into comparatively few primary branches of the capillitium. Capillitium consisting of slender brown threads which fork several times, the ultimate branches of which are attached to the persistent patches of sporangium wall. Spores in mass copper-red, nearly colorless by transmitted light, globose, minutely spinulose, about 8 mu in diameter.

TEB 565 and 566 fruited on June 25, 1940 on bark collected in Geary County, Kansas, and kept in moist chambers.

The spores of this species are described by Lister (9) as pale brown and smooth, and by Macbride and Martin as violaceous and smooth (10). In the collections described above the spores are nearly colorless when mounted either in water or a 3 percent solution of KOH, and are minutely but distinctly spinulose. The stalks are often uneven, but do not show

the swollen portion about two-thirds of the way up from the base as noted by some writers. As many as six or seven of the ultimate branches of the capillitium may be attached to the same persistent patch of the sporangium wall.

FAMILY ARCYRIACEAE

Fructification sporangiate, plasmodiocarpous, or rarely aethalioid. Capillitium a network of tubular threads attached below and marked with spines, cogs, or rings, but not with spiral bands. Spores in mass some shade of yellow or red.

KEY TO GENERA OF ARCYRIACEAE

1. Capillitium elastic. . . . . 18. Arcyria.

1. Capillitium not elastic.

2. Sporangium wall single, not containing refuse matter. 19. Lachnobolus.

2. Sporangium wall usually double, the outer layer containing granular refuse matter. . . . . 20. Perichaena.

Genus 18. Arcyria Wiggers

Fructification sporangiate, sessile or stalked. Sporangium wall single, membranous, evanescent above, persistent below as a shallow cup, the calyculus. Capillitium forming an elastic network of threads marked with spines, cogs, rings, or reticulations.

Key to Species of Arcyria

1. Capillitium almost or entirely free from the calyculus.

2. Sporangia tawny . . . . . 1. A. magna.

2. Sporangia flesh colored or reddish brown. . . . 2. A. incarnata.

1. Capillitium attached to the calyculus.

2. Sporangia globose to subglobose . . . . . 3. A. pomiformis.

2. Sporangia ovate to cylindric.

3. Sporangia cinereous to yellowish . . . . . 4. A. cinerea.

3. Sporangia pale rose in color . . . . . 5. A. insignis.

3. Sporangia brick red fading to reddish brown.

4. Expanded capillitium short, not flexuose; stalk 0.5-0.8 mm in length. . . . . 6. A. denudata.

4. Expanded capillitium far expanded, flexuose; stalk 1.2-1.7 mm in length. . . . . 6a. A. denudata extendens.

1. Arcyria magna nov. Sporangia closely clustered, stalked or sessile, cylindric, 2-3 mm tall when expanded, tawny. Sporangium wall evanescent except for the shallow, membranous, somewhat iridescent calyculus. Stalk weak, brownish, up to 1 mm in length, arising from a continuous, membranous hypothallus. Capillitium centrally attached, far expanded, forming a very loose, elastic network of almost colorless, regular threads marked with cogs and half cogs. Spores almost colorless by transmitted light, globose, almost smooth, marked with scattered colorless papillae, 7.2-8.3 mu in diameter.

Not uncommon on decaying tree stumps. Kansas: E. F. Roberts 8, as A. incarnata Pers., Riley County, August 21, 1897; TEB 234, Geary County, July 20, 1936.

A. magna differs from A. nutans (Sull.) Grev. in the absence of reticulation on the capillitium and calyculus, and the more delicate markings of the threads (10). Typical specimens of A. nutans apparently have not been collected in Kansas.

2. Arcyria incarnata Pers. Sporangia gregarious to closely crowded, stalked, flesh colored to reddish brown. Sporangium wall evanescent above, persistent below as a shallow, minutely roughened, somewhat iridescent, plicated calyculus. Stalk brown, longitudinally furrowed, weak, 0.1-0.4 mm in length, mounted on a brownish, more or less continuous hypothallus. Capillitium a loose, elastic network of pale reddish threads attached at the center of the cup only; threads 2-3 mu in diameter, marked with transverse plates, cogs, and ridges. Spores nearly colorless by transmitted light, globose, minutely warted, 6.7-7.8 mu in diameter.

On decaying wood. Kansas: TEB 247, Geary County, July 21, 1936.

TEB 779 collected by Mrs. Brooks in Edwards County, Kansas, in August, 1940 differs from the above collection in a few details. The sporangia are somewhat darker in color. The capillitium is irregular, varying from 3-5 mu in diameter, and expanded at intervals into bulbous swellings. The spores are 7.2-8.3 mu in diameter.

3. Arcyria pomiformis (Leers) Rost. Sporangia gregarious to scattered, stalked or sessile, globose to subglobose, occasionally short cylindric, 0.2-0.6 mm in diameter, ochraceous. Sporangium wall thin, membranous, colorless, iridescent, evanescent except for the narrow, shallow, plicate calyculus. Stalk pale brown, up to 0.5 mm in length, densely filled with sporelike cells, mounted on an inconspicuous, membranous, colorless hypothallus. Capillitium only slightly elastic, attached to the inner surface of the calyculus, forming an open network of yellowish threads closely

marked with spinules and sometimes a subreticulum. Spores in mass yellow, nearly colorless by transmitted light, globose, smooth, 7.8-10 mu in diameter.

Not uncommon on decaying wood. Kansas: TEB 353, Geary County, October 8, 1937; TEB 546, Geary County, May 25, 1940; TEB 753, Geary County, August 15, 1940.

TEB 623, collected by Mrs. Brooks in Edwards County, Kansas, in August, 1940, was identified as this species by Nagelstein.[18] The sporangia are shaped like A. cinerea, but seem to be more closely related to A. pomiformis because of the color and less dense capillitial network. The capillitial threads have spines arranged in a decussate manner which gives a false impression of diagonal lines.

4. Arcyria cinerea (Bull.) Pers. Sporangia gregarious to scattered, stalked, subglobose to cylindric, tapering upwards, 1-3 mm tall when expanded, cinereous to yellowish. Sporangium wall evanescent except for the small, thin, shallow, somewhat iridescent calyculus. Stalk somewhat iridescent, dark, slender, 0.3-1.2 mm in length. Hypothallus scanty. Capillitium attached to the inner surface of the calyculus, dense, only slightly elastic; threads yellowish by transmitted light, closely spinulose or nearly smooth, 7.2-8.3 mu in diameter.

Common on decaying wood. Kansas: H. F. Roberts 6, as A. albida Pers., Riley County, June, 1898; F. U. G. Agrelius 23, Douglas County, July 13, 1907; TEB 244, Geary County, June 14, 1936; TEB 776, collected by Mrs. Brooks in Edwards County, August, 1940.

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[18] See footnote 2, p. 18.

5. Arcyria insignis Kalch. & Cooke. Sporangia gregarious or in clusters up to 4 mm across, stalked to nearly sessile, cylindric, 0.4-1.7 mm tall when expanded, pale rose in color, fading to ochraceous. Sporangium wall persistent at base as a shallow calyculus. Stalk 0.1-0.3 mm in length, longitudinally furrowed, filled with sporelike cells, pale red, mounted on a more or less continuous, colorless, membranous hypothallus. Capillitium a close elastic network attached to the calyculus, threads 2-3 mu in diameter, colorless by transmitted light, marked by faint transverse thickenings or occasionally spinulose, with few free ends. Spores colorless by transmitted light, globose, smooth, 7-9 mu in diameter.

Not uncommon on decaying wood and herbaceous stems. Kansas: TEB 484, Geary County, July 16, 1938; TEB 485, Riley County, August 18, 1938; TEB 797, Riley County, October, 1940.

Distinguished from A. denudata by the smaller size, shorter stalks, and the more delicate capillitium.

6. Arcyria denudata (L.) Wettstein. Sporangia gregarious or closely crowded, stalked, ovate to short cylindric, when expanded 2-4 mm tall, brick red fading to yellowish brown or reddish brown. Sporangium wall evanescent except for the shallow or deep, plicate calyculus. Stalk red weathering to brown, longitudinally striate, 0.5-0.8 mm in length, filled with sporelike cells, mounted on a scanty brown hypothallus. Capillitium attached to the inside of the calyculus, forming an elastic network; the threads brownish by transmitted light, 3-4 mu in diameter, marked with half ooge, ooge, and occasionally also with warts. Spores almost colorless by transmitted light, globose, almost smooth, with a few scattered, colorless warts per hemisphere, 5.6-7.8 mm in diameter.

Common on dead wood. Kansas: A. S. Hitchcock as A. punicea, Riley County, August 7, 1893; H. F. Roberts 9, as A. punicea, Riley County, July, 1897; H. F. Roberts 10, as A. punicea, Riley County, June 1, 1898; H. F. Roberts 11, as A. punicea, Riley County, July 1, 1897; F. U. G. Agrelius 21, Harvey County, August 27, 1907; F. U. G. Agrelius 25, Douglas County, July 15, 1907; TEB 39, 41 and 42, Geary County, April 18, 1936; TEB 286, Geary County, June 13, 1937; TEB 612, Geary County, August 20, 1940; TEB 751, Riley County, September 27, 1940.

Easily distinguished from A. incarnata by the attachment of the capillitium.

6a. Arcyria denudata extendens nov. var. Sporangia gregarious, 5-8 mm in height when expanded, cylindrical. Stalk 1.2-1.7 mm in length. Capillitium attached to the inner surface of the calyculus, brick red in color, flexuose, far expanded, forming a loose, elastic network of regular threads. Spores about 7 mu in diameter.

On decaying wood. Kansas: TEB 752 (type collection), Riley County, September 6, 1940.

Differing from A. denudata in the far expanding, flexuose capillitium and the longer stalks.

Genus 19. Lachnobolus Fries

Fructification sporangiate. Sporangium wall single, membranous, persistent below as an irregular, shallow cup. Capillitium not elastic.

1. Lachnobolus congestus (Somm.) Lister. Sporangia sessile, subglobose, heaped in clusters less than 1 mm across, 0.1-0.4 mm in diameter, ochraceous. Sporangium wall a firm, shining, opalescent, ochraceous,

marked with warts and short ridges, irregularly dehiscent above leaving a shallow persistent cup. Capillitium a much branched network of ochraceous to pale, slender, hollow threads attached to the sporangium wall, varying from 4-9 mu in diameter, closely marked with an irregular or regular reticulation or studded with stout warts. Spores ochraceous in mass, pale yellow by transmitted light, nearly smooth, marked with a few scattered colorless warts, 7-8 mu in diameter.

Collected twice on bark near Newton, Kansas by F. U. G. Agrelius in August, 1907.

This genus stands intermediate between Perichaena and Arcyria. The sporangium wall of Perichaena is usually double, whereas the sporangium wall of Lachnobulus is single and somewhat persistent. In Arcyria the sporangium wall disappears soon after maturity. The capillitium of Arcyria is elastic, but in Lachnobolus the capillitium is not elastic. Lister (9) describes the sporangia as pale copper colored fading to ochraceous.

Genus 20. Perichaena Fries

Fructification sporangiate, plasmodiocarpous, or rarely aethalioid. Sporangium wall usually double, the outer layer containing granular refuse matter. Capillitium scanty or abundant, not elastic, and marked with spines or warts, sometimes nearly smooth.

Key to Species of Perichaena

1. Spores adhering in firm clusters . . . . . 1. P. syncarpon.

1. Spores free.

2. Sporangia flattened, many sided from mutual pressure. 2. P. depressa.

2. Sporangia subglobose, globose or pleurodiocarpous.

3. Dehiscence circumsciasile . . . . . 3. P. corticalis.

3. Dehiscence irregular.

4. Sporangium wall cartilaginous. . . . . 4. P. chrysosperma.

4. Sporangium wall more or less membranous. . . . 5. P. vermicularis.

1. Perichaena synocarpon sp. nov. Sporangia scattered to gregarious or crowded, sessile, somewhat hemispheric on a broad base to broadly pulvinate, 0.1-0.6 mm in diameter, or forming irregular, broadly pulvinate aethalia up to 1 mm across, with irregular jutting walls completely or incompletely partitioning the aethalium into spore cases, yellowish brown, dark reddish brown to nearly black in color. Sporangium wall of two layers, the outer cartilaginous, brittle, opaque, with deposits of brown granular matter, closely adhering to the inner layer which is a thin colorless membrane, dehiscing into areolae along prefixed raised lines. Hypothallus none. Columella none. Capillitium scanty, forming a loose net attached to the sporangium wall, composed of slender, yellow, hollow threads varying in thickness, nearly smooth and marked with regular, minute, close-set constrictions. Spores golden yellow in mass, pale yellow by transmitted light, adhering in clusters of 8-15, spinulose, more strongly spinulose on the outer surface as they lie in the cluster, 10-12.2 mu in diameter, averaging 11.3 mu.

Apparently not rare. Found on decaying leaves. Kansas: TEB 495, Geary County, August 21, 1938; TEB 681, Riley County, August 19, 1940 (type); TEB 734, Saline County, August 22, 1940; TEB 760, Edwards County, August 4, 1940.

The Genus Minakatella G. Lister containing the single species M. longifila G. Lister is known only from a single collection of four clusters of sporangia. Minakatella differs from Perichaena in the aethalioid habit and smooth capillitium. In these characteristics the present species approaches the conception of the former genus, the sporangia being scattered to gregarious or crowded, or more or less confluent into aethalia, and the capillitium composed of slender, yellow hollow threads which are nearly smooth, but marked with regular minute constrictions. Whether this species should be placed in the little known genus Minakatella, which is supposedly closely related to Periohaena, or in Perichaena to which its relationships are clear is undecided. However the latter view is taken because the species is more closely related to the species of Periohaena than it is to M. longifila.

The adherence of the spores in clusters is the most significant feature of this species. The capillitium, consisting of slender tubes, and the yellow spores make this a species of Periohaena. The spores in all other species of Perichaena are free. As this feature is constant in these collections the species should be regarded as distinct.

The sporangia are scattered or clustered in small colonies of mutually compressed sporangia, or forming plasmodiocarps up to 1 mm across, and dissected by irregular jutting walls which completely or incompletely partition the plasmodiocarp into spore cases. All phases are seen between the scattered sporangia and the irregularly dissected plasmodiocarps. When the sporangia are clustered into colonies they are often somewhat hemispheric, but the irregularly dissected plasmodiocarps are broadly pulvinate like the separate sporangia.

Although the sporangium wall does not apparently consist of two layers, the thin membranous inner layer is occasionally noticeable along the lines of dehiscence. The spore cases dehisce into irregular areolae along raised lines evident even in the immature sporangia.

2. Poriohaena depressa Libert. Sporangia gregarious or occasionally scattered, sessile, thin, flattened, 0.2-1.7 mm in diameter, usually appearing polygonal by mutual pressure, shiny, yellow to dark brown in color. Sporangium wall double, the outer layer usually more or less charged with brown granular matter above, cartilaginous, sometimes absent, closely adhering to the thin, firm membranous inner layer which is colorless and iridescent; dehiscence circumscissile, Hypothallus none. Capillitium abundant, scanty, or absent, consisting of slender seldom branching yellow threads attached to the sporangium wall, especially the base, 3-6 mu in diameter, marked with minute constrictions, minutely warted, or nearly smooth. Spores yellow in mass, pale yellow by transmitted light, globose or subglobose, minutely spinulose or warted, or nearly smooth, 8.3-11.7 mu in diameter, averaging 10.5 mu.

Occurring not uncommonly on the inner bark of dead trees and logs where the bark is partially but not entirely separated or occasionally on the outer bark in the crevices and on decaying twigs. Commonly found fruiting on the dead attached leaves of yucca plants in pasture land, a most unusual habitat for this species. Kansas: TEB 31, Geary County, April 5, 1936; TEB 35, Geary County, April 11, 1936; TEB 251, Geary County, April 11, 1936; TEB 682, Riley County, September 22, 1940.

Poriohaena depressa usually can be easily identified by the flattened polygonal sporangia with circumscissile dehiscence, but there are many

intermediates between this species and P. corticalis from which it is sometimes difficult to separate unless typical fruitings occur with the intermediate forms.

One collection, not cited above, was collected in Geary County in June, 1938 on the outer bark of a cottonwood log. The outer layer of the sporangium wall is charged with colorless granular matter as well as brown granular matter, giving the sporangia a cameocent appearance. Lime often occurs on the sporangium wall of this species. The granules in this specimen are not lime, however, as they will not dissolve in lactic acid.

3. Perichaena corticalis Rost. Sporangia scattered or gregarious, sessile on a broad or narrow base, depressed, globose, subglobose, or ellipsoid, 0.1-0.4 mm in diameter, or forming short plasmodiocarps up to 0.6 mm in length, dark brown, bronze brown, purplish black, or dull ochraceous in color. Sporangium wall consisting of two layers, the outer layer cartilaginous, charged with brown granular matter, often very much thickened and then brittle, closely adhering to the thin membranous inner layer which is colorless and iridescent, dehiscence circumscissile, by areolae, or irregular. Hypothallus scanty or none. Capillitium abundant, scanty, or none, yellow in color, attached to sporangium wall, when abundant consisting of seldom branching threads marked with short blunt spines and minutely constricted, or nearly smooth, when scanty consisting of rarely branching threads 60-80 mu in length, tips usually much swollen, marked with minute constrictions and warts, or nearly smooth. Spores yellow in mass, pale yellow by transmitted light, mostly globose, minutely warted, 9-16 mu in diameter.

Not uncommon on inner bark of trees and logs on which the bark has loosened but not separated, and on decaying twigs. Several collections are on decaying leaves. Kansas: TEB 12, Geary County, April 3, 1936; TEB 36, Geary County, April 11, 1936; TEB 37, Geary County, April 18, 1936; TEB 240, Geary County, November 8, 1936; TEB 348, Geary County, October 6, 1937; TEB 614, Geary County, August 20, 1940; TEB 719, Riley County, September 15, 1940; TEB 727, collected on leaves in Riley County by Mrs. Brooks, November 3, 1940; TEB 767, Geary County, July 17, 1938.

Distinguished from P. depressa principally by the much less flattened sporangia. There are, however, many intermediate phases and identification is often difficult. Of the collections cited above four probably approach the typical phase. These are all on bark or fallen twigs. In TEB 12 the sporangia are somewhat hemispheric, bronze red, with circumscissile dehiscence, while the capillitium is scanty or none. The sporangia of TEB 348 and 767 are somewhat hemispheric, but are polygonal by mutual pressure. In the upper part of the sporangium the wall is charged with granular matter and thickened, but where the sporangia are almost in contact the sporangium wall is thin, membranous and yellow. The capillitium is abundant and marked with short blunt protuberances. The dehiscence is circumscissile.

Two collections on the inner bark of cottonwood identified by Mr. Nagelstein as this species are placed here doubtfully. In TEB 36 the wall appears single and contains small amounts of granular matter. The capillitium consists of almost smooth branched threads. The sporangium wall of TEB 37 is covered with many wartlike tubercles. Many bulbous expansions are present on the much branched abundant capillitium which is marked with an obscure, incomplete reticulum often resembling

spirals, and minutely spinulose. The dehiscence of both collections is irregular.

Of considerable interest are several collections fruiting on decaying leaves not in close proximity to decaying wood.. The sporangia are usually crowded in small colonies, but may be gregarious or scattered, depressed globose or forming short plasmodiocarps, 0.1-0.4 mm in diameter, nearly black in color. The sporangium wall consists of two layers, the outer layer being very thick and heavily charged with granular matter, somewhat brittle, closely adhering to the thin, colorless, somewhat iridescent, membranous inner wall. Dehiscence circumscissile or by areolae. The capillitium of TEB 240 is scanty, consisting of slender, simple threads 60-80 mu in length, and marked by minute constrictions and warts. The tips of the capillitial threads are somewhat swollen and incrusted with red rodshaped crystals which are slowly dissolved in lactic acid. The capillitium of TEB 719 and 727 is similar, but instead of the striking red tips the treads are either naked, or incrusted with white granules.

4. Poriohaena chrysosperma Lister. Sporangia gregarious or scattered, sessile, globose, or forming short, annulate, or branched plasmodiocarps, light brown to nearly black, or orange in absence of outer wall. Sporangium wall consisting of two layers, the outer layer cartilaginous, thickly charged with brown granular matter, often incomplete, closely adhering to the colorless membranous inner layer, dehiscence irregular. Hypothallus scanty. Capillitium abundant, consisting of seldom branching yellow threads, 2.5-4.5 mu in diameter, marked with spines up to 3.5 mu in length, smooth, or warted with occasional long spines. Spores yellow in mass, pale yellow by transmitted light, globose, spinulose, 8-12 mu in diameter.

Common on inner side of bark which has not become completely detached from the log, and occasionally on wood. Kansas: TEB 294, Geary County, June 13, 1937; TEB 349, Geary County, October 6, 1937; TEB 488, Geary County, July 17, 1938; TEB 692, collected by the writer and Mrs. Brooks in Riley County, September 29, 1940; TEB 742, Riley County, September 29, 1940; TEB 766, Geary County, July 17, 1938.

Macbride and Martin (10) still retain Ophiotheca chrysosperma Currey and O. wrightii Ber. & Br. as separate species on the basis that O. chrysosperma is brown or yellowish brown with a minutely spinulose capillitium, and that the latter is chestnut brown or blackish with a strongly spinulose capillitium. Such a correlation of characters cannot be observed in the Kansas material and so Lister's conception of the species must be accepted.

5. Perichaena vermicularis Rost. Sporangia scattered, sessile, subglobose, 0.2-0.4 mm in diameter, or forming short, flexuose, or netlike plasmodiocarps, light brown to dark brown or canescent. Sporangium wall double, the outer layer often incomplete above, charged with brown granular matter, closely adhering to the thin, colorless, membranous inner layer which is regularly warted. Hypothallus continuous, or occasionally scanty. Capillitium abundant, composed of seldom branching yellow threads, minutely warted. Spores yellow in mass, nearly colorless by transmitted light, usually globose, minutely warted, 9.5-12 mu in diameter, averaging about 11 mu.

On bark and twigs of dead boxelder trees, trimmings of boxelder, and also on decaying herbaceous stems. Geary County, Kansas: TEB 233, June 5, 1936; TEB 452, July 17, 1938; TEB 482, July 17, 1938.

FAMILY TRICHIACEAE

Fructification plasmodiocarpous or sporangiate. Capillitium composed of tubular threads united more or less to form a network, or free in the spore mass, marked by spiral bands or an irregular reticulation. Spores in mass some shade of yellow or red.

KEY TO GENERA OF TRICHIACEAE

1. Capillitial threads united more or less to form a network.
   2. Capillitial threads marked with regular spirals. 21. Hemitrichia.
   2. Capillitial threads marked with an irregular reticulation interrupted at intervals by cogs or half cogs . . . . . 22. Calonema.
1. Capillitial threads free (elaters).
   2. Spiral bands regular. . . . . 23. Trichia.
   2. Spiral bands imperfect. . . . . 24. Oligonema.

Genus 21. Hemitrichia Rost.

Fructification plasmodiocarpous or sporangiate. Capillitium a loose network of twisted, centrally attached threads marked with spiral ridges. Spores in mass some shade of red or yellow.

Key to Species of Hemitrichia

1. Fructification plasmodiocarpous, yellow. . . . . 1. *H. serpula.*
1. Fructification sporangiate.
   2. Sporangia clustered, dark red to nearly black . 2. *H. vesparium.*
   2. Sporangia gregarious, yellow. . . . . 3. *H. stipitata.*

1. Hemitrichia serpula (Scop.) Rost. Fructification plasmodiocarpous, netlike, terete, rarely forming distinct, subglobose sporangia, tawny or yellow, dehiscing longitudinally along the apex. Sporangium wall membranous, yellowish, without deposits of refuse matter, shiny, occasionally somewhat iridescent. Hypothallus subcartilaginous, continuous, brown. Capillitium a tangle of long, seldom branching, sparingly spinulose, yellow threads; spiral ridges 4, connected by less prominent longitudinal ridges. Spores yellow in mass, pale yellow by transmitted light, globose, reticulate, 11-13 mu in diameter.

Apparently common on wood, but this species has not been collected in Kansas since 1906. Kansas: H. F. Roberts 24, as Hemiarcyria serpula (Scopoli) Rost., Riley County, October 25, 1897; H. F. Roberts, Riley County, 1898; F..U. G. Agrelius 33, Douglas County, November, 1906.

Easily recognized by the yellow, netlike plasmodiocarps.

2. Hemitrichia vesparium (Batsch) Macbr. Sporangia clustered or crowded, occasionally single, stalked or sessile, crateriform, obovoid to subcylindric, 0.5-1.2 mm in length, 0.3-0.5 mm in diameter, brownish, dark red to nearly black in color, usually somewhat iridescent, with circumscissile dehiscence. Sporangium wall cartilaginous, glossy or dull, opaque. Stalk dark red, solid, usually confluent, up to 1.7 mm in length. Capillitium brick red, composed of long, flexuose, sparingly branched threads intertwisted and coiled in the sporangium, attached at the base only; threads marked by four regular spiral ridges, spinulose, with free ends acuminate. Spores in mass brick red, reddish orange by transmitted light, globose to subglobose, warted, 9-11 mu in diameter.

Common on decaying wood. Kansas: A. S. Hitchcock, as H. rubiformis Pers., Riley County, August 7, 1893; A. S. Hitchcock, as H. rubiformis, Riley County, August 14, 1893; M. F. Roberts 23, as H. rubiformis, Riley County, August 21, 1897; TEB 7, Geary County, January 1, 1938; TEB 460, Geary County, July 10, 1938; TEB 468, Geary County, July 17, 1938; TEB 798, Riley County, May 29, 1940.

3. Hemitrichia stipitata (Massee) Macbr. Sporangia gregarious, stalked, subglobose or turbinate, yellow or olivaceous yellow, 0.5-1.2 mm in diameter. Sporangium wall yellowish, shiny, membranous, evanescent except at the base. Stalk reddish brown filled with sporelike cells, slender, 0.5-1 mm in length. Capillitium yellow to olivaceous yellow, dense, threads marked with 4 or 5 regular spirals, minutely spinulose, with few free ends. Spores in mass yellow, almost colorless by transmitted light, globose or subglobose, minutely spinulose to delicately reticulate, 6-8.3 mu in diameter.

Common on decaying wood. Kansas: M. F. Roberts, as H. clavata Pers., Riley County, summer, 1897; M. F. Roberts 21, as H. clavata Roet., Riley County, August 16, 1897; M. F. Roberts 21a as H. clavata Roet., Riley County, August 17, (1893?); F. U. C. Agrelius 27, Douglas County, November 17, 1906; F. U. C. Agrelius 29, as H. clavata, Harvey County, August 27, 1907; TEB 264, Geary County, July 4, 1937; TEB 325, Geary County, July 4, 1937; TEB 800, Geary County, August 21, 1940.

Genus 22. Calonema Morgan

Capillitium more or less united to form a network of threads marked with an irregular reticulation interrupted at intervals by cogs or half cogs.

1. Calonema aureum Morgan. Sporangia sessile, gregarious or heaped, subglobose, 0.3-0.5 mm in diameter, golden yellow in color. Sporangium wall single, membranous, thin and irregularly dehiscent above, thicker and persistent as a deep cup below, marked with delicate branching thickenings forming a fanlike tracery. Capillitium abundant, composed of much branched slender yellow threads mostly 4.5-5.5 mu in diameter, nodes and occasional free ends enlarged as bulbous thickenings, marked with an irregular reticulation interrupted at intervals by oogs or half oogs. Spores yellow in mass, pale yellow by transmitted light, globose, regularly reticulated by narrow raised lines which form a border of about 5 or 6 meshes across the hemisphere, body of spore 11-11.7 mu in diameter.

TEB 770, collected on decaying wood by L. R. Moodie in Kansas, is without further data.

This was regarded by Macbride and Martin (10) as distinguished from Hemitrichia by the markings on the capillitium and from Oligonema by the capillitial net. Lister considers this species hardly more than a variety of Oligonema flavidum Peck with which it is connected by intermediate forms (9). Lister retains the genus for convenience in classification. About the only difference between Oligonema flavidum and Calonema aureum is the presence of elaters in the former and a capillitial net in the latter.

Genus 23. Trichia Hall.

Fructification sporangiate. Capillitium composed of simple or sparingly branched threads free in the spore mass; spiral bands regular. Spores in mass yellow.

Key to Species of Trichia

1. Spores minutely warted; elaters marked with 2 spiral bands. 1. T. varia.

1. Spores usually reticulated; elaters marked with 4-5 spiral bands.

2. Spores minutely and closely reticulated, or irregularly warted. 2. T. scabra.

2. Spores coarsely reticulated.

3. Spores reticulated with pitted bands forming a more or less complete net. . . . . 3. T. affinis.

3. Spores with reticulation broken or represented by irregular pitted warts. . . . . 4. T. persimilis.

1. Trichia varia Pers. Sporangia gregarious, sessile or short stalked, globose, subglobose, or forming short, flexuose, terete plasmodiocarps, 0.5-0.8 mm in diameter, olivaceous, seated on a thin, membranous hypothallus, dehiscing irregularly. Sporangium wall membranous, yellow. Stalk short, black. Capillitium yellow, composed of long, cylindric threads marked with two somewhat irregular spiral bands, smooth, 4-5 mu in diameter, with long tapering ends. Spores yellow in mass, pale yellow by transmitted light, globose to subglobose, minutely warted, 10.5-13 mu in diameter.

On decaying wood. Kansas TEB 241, Geary County, November 2, 1936; collected by the writer in Geary County in 1937.

2. Trichia scabra Rost. Sporangia crowded, sessile, globose, 0.4-0.6 mm in diameter, shiny, golden yellow, dehiscing irregularly. Sporangium wall thin, membranous, pale yellow. Capillitium yellow, composed of long, cylindric threads marked with about 4 spiral bands, sparingly spinulose, with tips tapering abruptly or almost truncate; longitudinal striae present.

Spores yellow in mass, pale yellow by transmitted light, subglobose, minutely and closely reticulated, or irregularly warted, 9-11 mu in diameter.

On decaying wood. Kansas: F. U. C. Agrelius 60, Douglas County, November 3, 1906.

3. Trichia affinis de Bary. Sporangia crowded, sessile, obovoid, 0.5-0.7 mm in height, 0.4-0.6 mm in diameter, shiny, ochraceous yellow, dehiscing irregularly. Sporangium wall membranous, pale yellow. Capillitium yellow, consisting of long elaters 5-6 mu in diameter, with tapered ends, marked with about 4 spiral ridges, sparingly spinulose, with longitudinal striae present. Spores in mass yellow, pale yellow by transmitted light, subglobose, reticulated with narrow fitted bands forming a more or less complete net, 8.3-9.4 mu in diameter; border about 1 mu wide.

On decaying wood. Kansas: H. F. Roberts 33, as T. chrysosperma Bull, Riley County, October 25, 1897.

Distinguished from T. persimilis by the more or less complete reticulation on the spores.

4. Trichia persimilis Karst. Sporangia crowded, globose to ovoid, sessile, 0.3-0.5 mm in diameter, yellow to yellow-brown, dehiscing irregularly. Sporangium wall membranous, pale yellow, marked with rows of short lines or minute warts. Capillitium yellow, consisting of long, cylindric elaters 4.5-5.5 mu in diameter, marked with about 4 spiral bands, spinulose, with tips acuminate or obtuse, usually ending in one or two spines; longitudinal striae usually present. Spores in mass yellow or yellow-brown, pale yellow by transmitted light, subglobose, with reticulation

broken, or represented by irregular pitted warts, 9-12 mu in diameter; border 1-1.5 mu wide, interrupted.

On decaying wood. Kansas: F. U. C. Agrelius 28, Douglas County, November 10, 1906; F. U. C. Agrelius 31, as Hemitrichia ovata (Pers.) Macbr., Douglas County, November 3, 1906; F. U. C. Agrelius 34, Douglas County, November 1, 1906; TEB 11B, Geary County, November 9, 1936; TEB 11C, Geary County, 1936; TEB 449, Geary County, July 23, 1938; TEB 741, collected by the writer and Mrs. Brooks, September 29, 1940.

Genus 24. Oligonema Rost.

Fructification sporangiate, densely crowded. Capillitium composed of short elaters faintly sculptured with spiral bands, and often with rings, ooge, or warts. Spores in mass yellow, warted or reticulate.

1. Oligonema flavidum Peck. Sporangia densely crowded, sessile, globose or subglobose, about 0.4 mm in diameter, golden yellow, dehiscing irregularly. Sporangium wall thin, membranous, yellow, shiny, papillate. Capillitium and spore mass yellow. Elaters yellow by transmitted light, simple or sparingly branched, often swollen in places, marked with minute warts arranged in the form of indistinct spirals, or occasionally with very faint spiral bands, with the ends blunt. Spores yellow by transmitted light, globose or subglobose, reticulated with narrow bands forming a more or less complete net, with body of spore 9-10 mu in diameter; border well developed, 1.5 mu wide.

On decaying wood. Kansas: H. P. Roberts, Riley County, August 9, 1897.

FAMILY MARGARITACEAE

Fructification plasmodiocarpous or sporangiate. Capillitium a system of solid threads.

Genus 25. Margarita Lister

Characters as in family. Capillitium of simple or sparingly branched solid threads occasionally attached to the sporangium wall.

1. Margarita metallica (Berk. & Br.) Lister. Sporangia scattered, sessile, subglobose or forming short plasmodiocarps, 0.1-0.4 mm in diameter, opalescent. Sporangium wall thin membranous, colorless, opalescent. Hypothallus scanty or none. Capillitium composed of solid, ochraceous yellow, unbranched threads coiled free in the sporangium, mostly 1.5-2 mu in diameter but occasional swellings up to 5.5 mu, marked with minute warts arranged in loose spirals. Spores dull ochraceous in mass, nearly colorless by transmitted light, globose, spinulose, 10-11 mu in diameter.

Kansas: TEB 397, developed in moist chamber on bark collected in Geary County, February 24, 1938; TEB 567, on decaying wood, Geary County, June 13, 1940.

The variety plasmodiocarpa R. E. Fries in which the sporangia are described as forming plasmodiocarps, appears to be unnecessary as the plasmodiocarps and globose sporangia occur in the same fruiting.

FAMILY CRIBRARIACEAE

Fructification aethalioid, plasmodiocarpous, or sporangiate. Sporangium wall membranous, studded with microscopic plasmodic granules. Capillitium none.

KEY TO GENERA OF CRIBRARIACEAE

1. Fructification aethalioid; sporangium wall not forming a net in the upper part . . . . . 26. Lindbladia.

1. Fructification sporangiate, stalked; sporangium wall forming a net in the upper part.

2. Sporangium wall with thickenings in the form of a delicate, persistent net. . . . . 27. Cribraria.

2. Sporangium wall with thickenings in the form of parallel ribs extending from the base to the apex of the sporangium and connected by delicate threads . . . . . 28. Dictydium.

Genus 26. Lindbladia Fries

Fructification aethalioid. Sporangium walls membranous, studded with plasmodic granules, dehiscing irregularly. Spores olivaceous-brown.

1. Lindbladia effusa (Ehr.) Rost. Sporangia combined to form an effused or pulvinate aethalium up to 12 cm across and 4 mm thick, with outer sporangia forming a shiny, brown or black cortex. Sporangium wall membranous, shiny, somewhat iridescent, pale purplish by transmitted light, studded with plasmodic granules. Hypothallus well developed, somewhat spongy in nature. Spores in mass ochraceous-brown, almost colorless by transmitted light, globose, marked with scattered warts, 6-7.2 mu in diameter.

On decaying wood. Kansas: TEB 473, Geary County, July 2, 1938; TEB 802, Geary County, August, 1938.

Genus 27, Cribraria Persoon

Sporangia gregarious, stalked. Sporangium wall with thickenings in the form of delicate, persistent net in the upper part.

Key to Species of Cribraria

1. Spores in mass ochraceous.
   2. Cup one third height of sporangium. . . . . 1. C. intricata.
   2. Cup obsolete or poorly developed.
      3. Nodes of net small, rounded, dark brown. . . . 2. C. tenella.
      3. Nodes brown, irregular . . . . . 3. C. dictydioides.
1. Spores brownish pink.
   2. Plasmodic granules large, 1.7-2.8 mu in diameter. 4. C. piriformis.
   2. Plasmodic granules less than 1.5 mu in diameter.
      3. Sporangia copper-colored . . . . . 5. C. cuprea.
      3. Sporangia darker, brown with red and violet tints. 6. C. languescens.
1. Spores in mass lilac.
   2. Sporangia usually elliptical to oblong; net poorly developed. 7. C. violacea.
   2. Sporangia globose; net well developed. 7a. C. violacea pulchella.

1. Cribraria intricata Schrad. Sporangia gregarious, stalked, erect or nodding, globose, 0.3-0.8 mm in diameter, ochraceous brown. Stalk dark brown, 0.7-1.5 mm in length; hypothallus scanty. Cup brown, one third height of sporangium, with margin toothed; net close, regular; nodes

numerous, black, thickened, often branched, giving off free rays, connected by from 2 to 6 slender threads. Spores ochraceous in mass, nearly colorless by transmitted light, globose, roughened with colorless warts, 5.6-7.2 mu in diameter.

On decaying wood. Kansas: TEB 323A, Geary County, July 5, 1937.

2. Cribraria tenella Schrad. Sporangia gregarious, stalked, nodding or erect, globose, 0.2-0.6 mm in diameter, ochraceous brown. Stalk dark brown, 0.8-1.4 mm in length. Cup obsolete or nearly so; net close, regular; nodes small, dark brown, rounded, or occasionally elongate, with free rays few or none, connected by from 2 to 6 slender threads. Spores ochraceous in mass, nearly colorless by transmitted light, globose, smooth, 5.6-6.7 mu in diameter.

On decaying wood. Kansas: TEB 544, Geary County, August 7, 1938.

3. Cribraria diotydioides Cooke & Balf. Sporangia gregarious, stalked, globose, 0.3-0.7 mm in diameter, ochraceous. Stalk dark brown, 0.6-1.7 mm in length; hypothallus scanty, dark brown. Cup absent, or imperfectly developed. Net close, regular; nodes numerous, brown, irregular, giving off free rays, connected by from 3 to 5 slender threads. Spores ochraceous in mass, nearly colorless by transmitted light, globose, nearly smooth, 5.6-7 mu in diameter.

On decaying wood. Kansas: H. F. Roberts, Riley County, June, 1898.

4. Cribraria piriformis Schrad. Sporangia gregarious or scattered, stalked, subglobose, 0.1-0.3 mm in diameter, erect or nodding, pale orange. Stalk slender, dark reddish orange, 0.5-1.5 mm in length. Cup about one third height of sporangium; net regular; nodes numerous, expanded or small and rounded, orange to dark red, connected by slender threads, with

plasmodic granules pale, 1.7-2.8 mu in diameter. Spores in mass brownish pink, nearly colorless by transmitted light, globose, minutely warted 7.2-8.3 mu in diameter.

On dead wood. Kansas: TEB 237, Geary County, May 20, 1937.

5. Cribraria cuprea Morgan. Sporangia gregarious, stalked, nodding, subglobose, 0.2-0.4 mm in diameter, copper-colored. Stalk dark red, slender, 0.5-1.5 mm in length; hypothallus none. Cup one third to two thirds height of sporangium, with margin undulate or somewhat toothed; net regular; nodes dark red, rounded or large and flat, connected by slender threads, with plasmodic granules pale, generally less than 1.5 mu in diameter. Spores in mass brownish pink, nearly colorless by transmitted light, globose or subglobose, faintly and minutely warted, 7-8.5 mu in diameter.

Not uncommon on decaying cottonwood and elm logs. Kansas: TEB 324, Geary County, July 4, 1937.

6. Cribraria languescens Rex. Sporangia gregarious, stalked, nodding or erect, subglobose, 0.1-0.6 mm in diameter, brownish with red and violet tints. Stalk brown, slender, 0.5-2.5 mm in length. Cup about one half height of sporangium, with margin almost even; net regular; nodes dark, usually rounded, occasionally flattened, with free rays few or none, connected by slender threads, with plasmodic granules pale, less than 1 mu in diameter. Spores in mass brownish, pale by transmitted light, globose, minutely warted, 7.2-8 mu in diameter.

On decaying cottonwood log. Kansas: TEB 756, Geary County, August 15, 1940.

7. Cribraria violacea Rex. Sporangia grogarious or scattered, stalked, elliptical or oblong, sometimes globose or subglobose, 0.05-0.2 mm in diameter, pale violet to dark blue or nearly black. Stalk usually more than two thirds total height, 0.1-0.5 mm in length, concolorous, tapering upwards; hypothallus none. Cup usually two thirds or more of the height of the sporangium, with the margin usually irregular; net poorly developed, consisting of a few broadly expanded violet nodes studded with pale violet plasmodic granules. Spores in mass lilac, pale lilac by transmitted light, globose, minutely warted, 7-8.3 mu in diameter.

Common on decaying grapevines, bark of dead and living trees, and decaying wood. Kansas: TEB 285, Geary County, June 13, 1937; TEB 502, Geary County, February 25, 1938; TEB 532, Geary County, March 29, 1938; TEB 534, Riley County, November, 1939; TEB 552, Geary County, May 4, 1940. Collections 502, 532, and 534 developed on moistened bark kept in moist chambers.

7a. Cribraria violacea pulchella nov. var. Sporangia grogarious, stalked, globose or almost so, 0.05-0.4 mm in diameter, violet-blue to nearly black. Stalk nearly black, 0.1-0.7 mm in length, tapering upwards, usually erect. Cup usually less than one fourth the height of the sporangium, rarely one third, with an irregular, toothed margin; net well developed, usually regular, with meshes usually small; nodes irregular, somewhat thickened or broadly expanded, violet-blue, connected by delicate, paler threads, with violet plasmodic granules. Spores in mass lilac, pale lilac by transmitted light, globose, minutely warted, 7-8.3 mu in diameter.

Collected repeatedly on a decaying coniferous timber near Junction City, Kansas: TEB 343, Geary County, September 6, 1937; TEB 343A, Geary County, December, 1937; TEB 343B, Geary County, January 15, 1938; TEB 343C, Geary County, January, 1938; TEB 343D, Geary County, February, 1938; TEB 343E, Geary County, August 21, 1938; TEB 343F, Geary County, May 6, 1940; TEB 343G, Geary County, May 7, 1940; TEB 343H, Geary County, May 23, 1940; TEB 343I, Geary County, June 8, 1940; TEB 343J, Geary County, June 13, 1940; TEB 343K, Geary County, August 21, 1940. Collections 343A, 343B, 343C, 343D, 343F, 343G, and 343H developed on pieces of the coniferous timber which were saturated with distilled water and kept in moist chambers.

Differing from typical C. violacea in the well developed net, shallow cup, and globose sporangia. Sporangia in C. violacea are sometimes globose but the net is almost always poorly developed and the cup is usually at least two thirds the height of the sporangium. This form is close to C. elegans Berk. & Curt. in the globose sporangia and well-developed net, but lacks the reddish violet color characteristic of that species.

Genus 28. Dictydium Schrader

Sporangia gregarious, stalked. Sporangium wall with thickenings in the form of parallel ribs extending from the base to the apex of the sporangium and connected by slender threads.

1. Dictydium cancellatum Macbride. Sporangia gregarious, stalked, subglobose, umbilicate above, 0.2-0.7 mm in diameter, nodding, reddish brown. Stalk dark red, tapering upwards, 0.5-1.5 mm in length. Cup nearly obsolete; net well developed, composed of nearly parallel ribs

transversely connected by delicate threads and extending from the base to the apex where the ribs often branch irregularly. Spores in mass reddish brown, pale lilaceous by transmitted light, globose, usually each spore with from 1 to 4 dark purple plasmodic granules on the surface, faintly warted, 5.5-6 mu in diameter.

Common on decaying wood. Kansas: F. U. C. Agrelius 49, Douglas County, November 25, 1907; C. L. Lefebvre, Riley County, September, 1933; TEB 235, Geary County, May, 1936; TEB 235A, Geary County, May, 1936; TEB 629, Geary County, August 18, 1940; TEB 777, collected by Mrs. Brooks in Edwards County, August, 1940.

FAMILY LICEACEAE

Sporangia gregarious or scattered, sessile, dehiscing by a more or less definite lid, by lobes, or irregularly. Sporangium wall membranous or cartilaginous, with plasmodic granules lacking. Hypothallus none. Capillitium none.

KEY TO GENERA OF LICEACEAE

1. Sporangia dehiscing by lobes or irregularly. . . 29. Licea.

1. Sporangia dehiscing by a more or less definite lid.

2. Sporangia brown; lid on the inner surface bearing blunt fingerlike processes at the center and several rows of papillae along the margin. . . . . 30. Kleistobolus.

2. Sporangia dark; lid papillose on the inner surface. 31. Hymenobolina.

Genus 29. Licea Schrader

Sporangia scattered or gregarious, sessile, dehiscing by lobes or irregularly. Sporangium wall membranous or cartilaginous. Hypothallus none. Capillitium none. Spores nearly colorless, violaceous, olive-yellow, olive-brown or brownish gray in color.

Key to Species of Licea

1. Sporangium wall cartilaginous.

2. Spores violaceous or olive-brown by transmitted light. 1. L. minima.

2. Spores almost colorless by transmitted light. 2. L. castanea.

1. Sporangium wall membranous.

2. Sporangia forming ellipsoid to elongate plasmodiocarps dehiscing longitudinally into two equal halves. . . . . 3. L. biforis.

2. Sporangia globose, conic, or hemispheric, dehiscing irregularly.

3. Spores pale olive-yellow by transmitted light. 4. L. tenera.

3. Spores dull brownish gray by transmitted light. 5. L. fimicola.

1. Licea minima Fr. Sporangia scattered, sessile on a broad base, 0.07-0.2 mm in diameter, hemispheric to pulvinate, dark brown to nearly black. Sporangium wall cartilaginous, dark brown, opaque with refuse matter, splitting along prefixed lines into segments which remain attached at the base. Spores brown in mass, violaceous by transmitted light with the spore wall brown and thinner on one side, globose, smooth, 8.3-10 mu in diameter.

A single natural collection, TEB 792, was found by Mrs. Brooks on the inner bark of a cottonwood log. Many abnormal developments of this

species have been found on the bark of various trees kept in moist chambers. In these abnormal developments the sporangia are usually less than 0.1 mm in diameter, and chestnut brown in color. The spores are olive-brown by transmitted light, paler on one side, minutely warted to nearly smooth, 8-16 mu in diameter.

Kansas: TEB 398, Geary County, December, 1937; TEB 488, Geary County, January 6, 1938; TEB 489, Geary County, November 30, 1937; TEB 500, Geary County, March 1, 1938; TEB 501, Geary County, February 17, 1938; TEB 502, 504, 505, and 506, Geary County, February 25, 1938; TEB 531, Geary County, February, 1936; TEB 553, Geary County, June 4, 1940; TEB 792, collected by Mrs. Brooke in Edwards County, February 10, 1941.

2. Licea castanea G. Lister. Sporangia scattered or gregarious, sessile, subglobose on a broad base or forming short plasmodiocarps, 0.2-0.3 mm in diameter, chestnut brown. Sporangium wall somewhat cartilaginous, pale brown, overlaid with a continuous layer of brown granular matter, separating along prominent, prefixed lines into lobes. Spores in mass olive-yellow, nearly colorless by transmitted light, subglobose, with a well-defined, thinner and paler area of dehiscence, smooth 11-13 mu in diameter.

TEB 591, developed July 7, 1940 on bark collected in Geary County, Kansas and cultured in a moist chamber.

With the exception of the size of the spores this collection agrees well with the description of L. castanea, the spores of that species being 8-10 mu in diameter in comparison to 11-13 mu for the present collection. From L. minima it differs in the much paler spore mass, and the nearly colorless, smooth spores.

3. Licea biforis Morgan. Sporangia scattered or gregarious, sessile, forming ellipsoid to elongate plasmodiocarps 0.1-0.3 mm long and 0.04-0.08 mm wide, yellowish brown, chestnut brown, to nearly black in color. Sporangium wall membranous, firm, nearly colorless, minutely papillose, with scattered deposits of refuse matter, dehiscing longitudinally into two equal halves which remain attached at the base. Spores ochraceous in mass, pale yellow by transmitted light, globose or ovoid, very faintly and minutely warted, 10-13 mu in diameter.

Commonly developing on bark of living trees kept in a moist chamber. Occasionally natural fruitings were found on fallen bark and twigs. Kansas: found on material collected by F. U. C. Agrelius in Harvey County, August 23, 1907; TEB 283, Geary County, June 13, 1937; TEB 391, Geary County, January, 1938; TEB 409, Geary County, December 11, 1937; TEB 427, Geary County, June 20, 1938; TEB 504 and 506, Geary County, February 25, 1938; TEB 509, Geary County, August, 1938; TEB 531, Geary County, February, 1938.

4. Licea tenera Jahn. Sporangia gregarious to scattered, sessile, subglobose to somewhat hemispheric, 0.01-0.05 mm in diameter, gray to yellowish in color, dehiscing irregularly. Sporangium wall membranous, almost colorless, papillose on the outer surface, usually with scanty deposits of refuse matter. Spores pale olive-yellow by transmitted light, globose or subglobose, often with the spore wall thinner on one side, minutely and faintly warted or smooth, 8.3-12.2 mu in diameter.

This species fruited abundantly on elm bark and lichens kept in a moist chamber. Kansas: TEB 370, Geary County, December, 1937; TEB 488, Geary County, January 6, 1938; TEB 503, Geary County, March 22, 1938; TEB 781, Edwards County, January 13, 1941.

5. Licea fimicola Dearness & Bisby. Sporangia scattered, sessile on a broad base, somewhat conic, 0.03-0.05 mm in diameter, nearly black, dehiscing irregularly. Sporangium wall membranous. Capillitium none. Spores black in mass, dull brownish gray by transmitted light, usually globose, smooth, thick walled, with the wall sometimes paler on one side, 11-12 mu in diameter.

A few sporangia of this species were found scattered among sporangia of Licea tenera which developed on bark kept in a moist chamber. Kansas: TEB 370, Geary County, December, 1937; TEB 488, Geary County, January 6, 1938.

Genus 30. Kleistobolus Lippert

Sporangia sessile, operculate, brown. Sporangium wall membranous; lid membranous, firm, bearing on the inner surface at the center blunt fingerlike processes and at the margin several rows of papillae. Spores nearly colorless by transmitted light.

1. Kleistobolus pusillus Lippert. Sporangia scattered, sessile on a broad base, discoid or subglobose, 0.04-0.07 mm in diameter, brown, opening by a lid. Sporangium wall membranous, firm, brown, with more or less dense deposits of refuse matter; lid membranous, firm, yellowish, sometimes with scanty deposits of refuse matter, convex, bearing on the inner surface near the center prominent fingerlike processes, and along margin the several rows of colorless papillae. Hypothallus none. Spores pale brown by transmitted light, globose, smooth somewhat coated with amorphous granules, 10-13 mu in diameter.

Cocurring as scattered sporangia among fruitings of other species developing in moist chambers on bark of living trees. Kansas: TEB 374A, Geary County, February, 1938; TEB 502, Geary County, February 25, 1938; TEB 527, Geary County, January 10, 1938.

Genus 31. Hymenobolina Zukal

Sporangia sessile, dark, with a more or less definite membranous lid papillose on the inner surface. Spores pale grayish brown by transmitted light, with a thinner area of dehiscence.

1. Hymenobolina parasitica Zukal. Sporangia scattered, sessile on a broad base, 0.1-0.3 mm in diameter, subglobose, nearly black, with an opalescent or yellow lid. Sporangium wall thickened and charged with granular matter below, opaque, brittle with a well-defined, membranous, transparent or somewhat opaque lid, papillose on inner surface. Hypothallus none. Capillitium none. Spore mass light brown in color, pale grayish brown by transmitted light with a well-defined, paler, thinner area of dehiscence, globose, smooth, 13-15 mu in diameter.

On boxelder bark. Kansas: TEB 621A, Geary County, June 5, 1936.

This collection may not represent H. parasitica because of the opalescent or yellow lid. In typical collections the lid is dark as is the remainder of the sporangium wall.

FAMILY TUBIFERACEAE

Fructification composed of densely clustered cylindric sporangia forming a pseudoaethalium. Sporangium walls membranous, without plasmodic granules.

Genus 32. Tubifera Gmelin

Sporangia cylindric, closely crowded on a common hypothallus.

Key to Species of Tubifera

1. Pseudoaethalium seated on a spongy, stalk-like base; spores about 5 mu in diameter . . . . . 1. T. stipitata.

1. Pseudoaethalium sessile, spores larger . . . . . 2. T. ferruginosa.

1. Tubifera stipitata (Berk. & Rav.) Macbr. Sporangia closely crowded in a globose or pulvinate head 4-17 mm in diameter and borne on a spongy stalk-like base, brown. Sporangium walls membranous, granular, thin, breaking away irregularly. Capillitium scanty, composed of slender, sparingly branched threads. Spores in mass brown, pale by transmitted light, globose, reticulate, 4.4-5.6 mu in diameter.

On wood. Kansas: TEB 231, Geary County, June 13, 1936.

2. Tubifera ferruginosa Gmel. Sporangia densely crowded, cylindric, polyhedral by mutual pressure, brown, 2-3 mm in length, about 0.4 mm in diameter, seated on a common spongy hypothallus. Sporangium wall membranous, thin, often iridescent, falling away irregularly, minutely warted. Capillitium none. Spores in mass brown, pale by transmitted light, globose, reticulated, 6-8 mu in diameter.

On wood. Kansas: F. U. G. Agrelius 73, Douglas County, May 9, 1909; TEB 310, Geary County, May 20, 1937.

FAMILY RETICULARIACEAE

Fructification aethalioid. Sporangium walls membranous, incomplete, forming a pseudocapillitium, without plasmodic granules. Capillitium lacking.

KEY TO GENERA OF RETICULARIACEAE

1. Sporangia columnar; pseudocapillitium consisting of 4 to 6 straight threads extending from the dome-shaped apical portion of the sporangium wall. . . . . 33. Dictydiaethalium.

1. Sporangia not columnar.

2. Pseudocapillitium composed of irregular plates fraying out into threads . . . . . 34. Reticularia.

2. Pseudocapillitium composed of broad, perforated plates. 35. Enteridium.

Genus 33. Dictydiaethalium Rost.

Fructification aethalioid. Sporangium wall incomplete, arched above, extending as 4 to 6 threads down to the base of the sporangium.

1. Dictydiaethalium plumbeum (Schum.) Rost. Aethalium composed of densely crowded columnar sporangia, thin, flat, varying from 0.3 mm to 2 cm in extent, brown. Sporangium wall complete above, extending down to the base as 4 to 6 straight threads which form the pseudocapillitium. Hypothallus well developed, silvery. Spores in mass ochraceous, pale by transmitted light, globose, minutely spinulose, 9-11 mu in diameter.

Not uncommon on decaying wood. Kansas: F. U. C. Agrelius 66, Harvey County, August 27, 1907; TEB 2, Geary County, March 29, 1936; TEB 535, Geary County, May 26, 1938.

Genus 34. Reticularia Bull. emend. Rost.

Fructification aethalioid, pulvinate. Pseudocapillitium composed of irregular plates fraying out into threads. Spores reticulate.

1. Reticularia lycoperdon Bull. Aethalia pulvinate, 2-3.5 cm across, shiny. Cortex somewhat persistent, falling away irregularly. Sporangium walls membranous, forming the pseudocapillitium which is composed of irregular plates fraying out into threads. Spores in mass brown, pale by transmitted light, subglobose, reticulate over two thirds of the surface, about 7 mu in diameter.

Not uncommon on dead wood. Kansas: E. P. Roberts 35 as Enteridium rozsanum Wingate, Riley County, August, 1897; F. U. C. Agrelius 36 as Lycogala flavofuscum (Ehr.) Rost., Douglas County, June 21, 1907; F. U. C. Agrelius 72, Douglas County, June 8, 1908; TEB 287, Geary County, June 13, 1937; TEB 418, Geary County, May 15, 1938.

FAMILY LYCOGALACEAE

Fructification aethalioid. Pseudocapillitium consisting of branching, colorless tubes.

Genus 36. Lycogala Adanson

Aethalia subglobose, enclosed by a cortex consisting of several closely combined layers.

Key to Lycogala

1. Superficial vesicles of the cortex homogeneous.

2. Aethalia 2-6 mm in diameter . . . . . 1. L. epidendrum.

2. Aethalia 1-2 mm in diameter . . . . . 1a. L. epidendrum exiguum.

1. Superficial vesicles of the cortex divided into numerous chambers. 1b. L. epidendrum tessellatum.

1. Lycogala epidendrum Fries. Aethalia gregarious, subglobose, 2-6 and more mm in diameter, tan or brown. Pseudocapillitium composed of wrinkled, branching, colorless tubular threads, arising from the innerside of the cortex. Spores ochraceous in mass, pale by transmitted light, globose, reticulate, 5-7 mu in diameter.

On wood. Kansas: TEB 245A, Geary County, July 4, 1937; TEB 801, Geary County, August 21, 1940.

1a. Lycogala epidendrum exiguum Lister. Aethalia dark brown, gregarious, subglobose, 1-2 mm in diameter. Superficial vessels of the cortex not chambered.

On wood. Kansas: TEB 245B, Geary County, July 4, 1937.

1b. Lycogala epidendrum tessellatum Lister. Aethalia gregarious or crowded, subglobose, dark brown, 0.1-0.8 mm in diameter. Superficial vessels of the cortex divided into numerous chambers.

On wood. Kansas: H. F. Roberts, Riley County, Summer, 1897; TEB 245, Geary County, July 4, 1937; TEB 559, Geary County, July 3, 1938.

SUMMARY

1. Previous to the present study approximately 45 species of slime molds representing 21 genera were listed as indigenous to Kansas.

2. During the period from 1936 to 1941 approximately 130 species representing 36 genera were collected in Kansas.

3. Among the species and varieties collected in Kansas Didymium parietale Martin and Brooks, D. rigidum Brooks, Perichaena synoarpon Brooks, Comatricha rufescens Brooks, Cribraria violacea pulchella Brooks, and Arcyria denudata extendene Brooks were found to be new to science. What is here described as Diderma lyallii (Mass.) Macbr. may possibly be a new species.

4. Besides these four new species Physarum aeneum Fries, P. ovisporum G. Lister, Didymium melanospermum bicolor G. Lister, Comatricha cornea G. Lister and Cran, and Licea castanea G. Lister were collected for the first time in North America.

5. The following species were collected for the first time outside of the locality where they were first collected: Physarum maculatum Macbr., previously collected in Central America; P. megalosporum Macbr., previously collected in Colorado; P. ovisporum G. Lister, previously collected in England; Macbrideola scintillans Gilbert, previously collected in Iowa; and Licea fimicola Dearness and Bisby, previously collected in Ontario.

6. The total number of slime molds known to be indigenous to Kansas at the present date approximates 140 species representing 37 genera and 12 families.

ACKNOWLEDGMENTS

Appreciation is expressed to Dr. F. C. Gates, Professor of Taxonomy and Ecology, for his invaluable aid in the preparation of the thesis; to Mr. Robert Nagelstein, New York Botanical Gardens, and to Dr. C. W. Martin, Department of Botany, State University of Iowa, Iowa City, Iowa, for authentic specimens of many species and for the identification or verification of the majority of the species and varieties collected in Kansas; to Prof. F. U. G. Agrelius, Kansas State Teachers College at Emporia, for the loan of a series of his collections of Myxomycetes; and to Mrs. Travis E. Brooks for aid in the preparation of the thesis.

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